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from the author

DISSERTATIONS

ON

SELECT SUBJECTS

IN

CHEMISTRY AND MEDICINE

BY

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OF CHEMISTRY IN THAT UNIVERSITY,
AND LATE FELLOW OF NEW COLLEGE.

Verum enimvero is demum mihi vivere atque frui animâ videtur, qui aliquo negotio intentus, præclari facinoris, aut artis bonæ famam quærit. Sed in magnâ copiâ rerum, aliud alii natura iter ostendit.

Sallust. præf. in Bell. Catalin.

Quod si non hic tantus fructus ostenderetur, si ex his studiis delectatio sola peteretur : tamen, ut opinor, hanc animi remissionem humanissimam ac liberalissimam judicaretis.

Ciceronis Orat. pro Archia Poeta.

O X F O R D :

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TO
THE RIGHT HONOURABLE
EDWIN, LORD SANDYS,
THE FOLLOWING DISSERTATIONS
ARE HUMBLY INSCRIBED;
NOT SOLELY AS A TESTIMONY
OF RESPECT
DUE TO HIS LORDSHIP'S
EMINENT ABILITIES AND ERUDITION;
BUT AS A TRIBUTE
OF GRATITUDE,
FOR THE NUMEROUS INSTANCES
OF FRIENDSHIP AND PATRONAGE,
WITH WHICH HIS LORDSHIP
HAS HONOURED
THE AUTHOR AND HIS FAMILY.

P R E F A C E.

THE motives, by which an author is persuaded to introduce himself to public notice, are sometimes anxiously inquired after by his readers; yet in general, when known, appear to them less interesting than they are represented by his own partial judgment. I do not esteem it necessary therefore to say many words on this subject. Those, who condescend to look into these treatises, will find in the title-page the principal source of my presumption, as far as it respects myself. If they are encouraged to read farther, they may discern unequivocal traces, that selfish views have not entirely biaſſed me, but that I have been in no inconsiderable degree influenced by an ardent zeal for the reputation of the University,

sity, in which I have the happiness to reside, and for the honour of that profession, with which I am connected not merely by title and degree, but, to use Dr Mead's expression, *gentilitio quasi Jure*. †

On these accounts I shall limit my introductory remarks to a very few observations, more immediately relative to the composition and publication of each of the following tracts.

The Inaugural Dissertation on the Study of Chemistry was read before the University, when the author was nominated to the Chemical Chair. At that time the noble benefaction of the EARL of LITCHFIELD for the establishment of a Chemical Professorship in the Radcliffe Infirmary had inspired in the minds of many very reasonable hopes, that medical science, and the study of the practical as well as theoretical branches of it, might be revived with singular advantages in this

† *Mead*, Præf. in Med. Sacr.

place. With peculiar alacrity I dedicated my services to the promotion of a plan so laudable. The members of convocation have likewise shewn a disposition to second and enforce the designs of the Professors of Medicine, first, by an unanimous assent to a proposal for shortening the time required for degrees in Medicine, so as to place the two Sister-Universities, Cambridge and Oxford, in this respect, as nearly as possible, upon an equal footing; and secondly, by the liberal assistance, which their Delegates afforded to the Lecturer in repairing the Laboratory, and accommodating it to the purposes of a Chemical school.

It is not therefore without foundation, that we feel and cherish a growing hope, that the science of Medicine may once more flourish in this soil, and that the various streams of benevolence, originally intended for its nurture and encouragement, may now be recalled to their proper channels, and employed in fertilizing that province,

vince, which they were destined to enrich and adorn.

This Dissertation was received with flattering marks of attention : and as several respectable persons are of opinion, that the publication of it at this time may tend still farther to promote the great cause, which at first suggested the composition of it, I have at last yielded to their partial judgment. No considerable addition is made to the Lecture itself, but some notes are subjoined to illustrate passages, which might otherwise have appeared incorrect, obscure, or imperfect.

THE SUBJECT of the Second Tract may not be thought so interesting as the former, yet it may at least afford amusement to some readers, whose studies have been directed to speculations of this nature : and it may upon examination be found to have more connection with the History of Chemistry, than at first sight appears : for
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if it be thereby demonstrated, that the Chemists adopted the hieroglyphic mode of writing from the Astronomers, it follows that Alchemy was not known, as some have pretended, in the earliest ages, nor 'till long after Astronomy was advanced to a considerable degree of perfection.

Scaliger, and after him the President de Goguet have slightly touched upon the invention of the astronomical characters. In some points of the explanation my system coincides with their observations, and may appear to have been borrowed from them: but long before I knew, that they had said any thing upon this subject, my own theory had been formed; and it was only in consequence of my researches in these authors, to render this tract more fit for the public eye, that I discovered their anticipation of a part of my plan.

I first gave a slight view of this system in my chemical lectures, and afterwards enlarged and extended it, as

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an Essay to be read before *The Literary and Philosophical Society of Manchester*, of which I had been lately elected an Honorary Member.

It is with great satisfaction, that I embrace this public opportunity of expressing my sense of this honour, which I cannot but regard as a testimony of their approbation of the zeal I have always felt, and have sometimes been enabled to display, for the advancement of the sciences most immediately connected with my Profession.

This Society affords a striking confirmation of the propriety of the observation advanced in the 75th page. The many ingenious Essays and Dissertations, produced by it's members, and read at their meetings, shew how naturally and irresistibly the latent sparks of genius are called into action by the principle of emulation, which such liberal associations inspire and support ; so true is it, as is most justly remarked in the short account of this
institu-

institution, which has been published,
“ That men, however great their learn-
“ ing, often become indolent, and un-
“ ambitious to improve in knowledge,
“ for want of associating with others
“ of similar talents and acquirements:
“ having few opportunities of com-
“ municating their ideas, they are
“ not very solicitous to collect or ar-
“ range those they have acquired, and
“ are still less anxious about the far-
“ ther cultivation of their minds. But
“ Science, like fire, is put in motion
“ by collision. Where a number of
“ such men have frequent opportu-
“ nities of meeting and conversing
“ together, thought begets thought,
“ and every hint is turned to advan-
“ tage. A spirit of inquiry glows in
“ every breast: each new discovery
“ relative to the natural, moral, or
“ intellectual world, leads to a farther
“ investigation, and each man pants
“ to distinguish himself in the inte-
“ resting pursuit.”

I am happy to have it in my power to add, that since the note, relative to the origin of the Royal Society, in the 75th page, was first written, the establishment of a *Medical Society* in this University by the voluntary and active exertions of the Students of Medicine, has, at least with respect to that branch of Science, rendered my observation less pertinent. The secure foundation, upon which this Society is established, and the assiduous attention of it's Members to every thing, that can promote the intention of this laudable institution, encourage a well-founded expectation, that no trifling advantages will from thence be derived to the Science of Medicine, to the University, and to the Public at large. At some future period, when this presage shall have attained it's full completion, the remembrance of their successful exertions will afford a subject for pleasing reflection to those members, whose industry and love of knowledge laid the basis of this association,

ciation, and to myself, who have had the honour to preside over and protect it's infant state.

THE THIRD TRACT is a Commentary upon some of the accounts of the Diseases prevalent in the South Sea Islands. It was once my intention to have made this commentary much more extensive, but the execution of that design was prevented by other more necessary engagements. As I have no reason to believe it will ever be in my power to complete this plan, I give this tract with diffidence to the public in it's present imperfect state, for which I would offer an apology, if I thought any one would be required.

The time of the appearance of the disease, which is the immediate subject of this Dissertation, may appear to some a matter of no great importance; and certainly it is unimportant to those, who in the practice of medicine have no guide, but Empiricism, and never extend their ideas to the historical, moral, and philosophical prin-

principles or consequences, so often combined with or dependant upon the rise and progress of diseases: for the history of diseases is a part, not inconsiderable, of the history of human nature, and intimately connected with the progress of luxury, intemperance, and every deviation from the simple laws of the animal œconomy. And therefore, in ascertaining the period of the first appearance of any disease, but particularly of one which originates from, and yet tends to annihilate, the very source of human existence, we make one important step not only in the general history of the progress of manners, but even in the history of the world.

Influenced by such powerful considerations, I could not but feel at the same time a secret satisfaction, arising from these pursuits, though from a different principle. The insinuations, which had been advanced to shew, that this calamity was an inveterate, and indeed an *indigenous*, plague amongst

amongst these new-discovered Islanders, had a tendency to cast a gloom over the more common and more pleasing contemplation of their state of simplicity and health, previous to the visit of the Europeans. An attempt to efface this injurious picture, and restore to them, with their native, unsuspecting, artlessness of manners, the unimpaired graces of strength and beauty, was a labour, which rewarded itself, by the sensations which it excited.

Having thus explained, as far as may be thought necessary, the principles, by which I have been persuaded to obtrude myself on the public, I submit myself to its examination, with doubt indeed and apprehension, yet assured, that, although Candour may find it impossible to commend the execution of my work, the motives, upon which it was undertaken, will plead strongly in my favour, and, I hope, disarm the severity of Censure.

OXFORD, *Monday,*
April 21. 1783.

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ERRATA.

- P. 14. lin. 23. for *Tellescopes* read *telescopes*.
P. 24. lin. 10. after *earth* and also after *stone* insert a comma.
P. 45. lin. ult. for *obserfvation* read *observation*.
P. 151. lin. 21. for *being* read *bring*.

T R A C T I.

A N INAUGURAL DISSERTATION ON THE STUDY OF CHEMISTRY:

Read in the Natural-Philosophy School,
Oxford, May 7. 1781.

Mr Vice-Chancellor, and Gentlemen,

THE Course of Lectures, to which this is proposed as an Introduction, is intended as part of a plan to revive the study of Medicine in this Place. This illustrious Seminary has for ages held a most distinguished rank in the republic of letters; and been deservedly celebrated, where even the first dawnings of Science have shone, as the mother of many great and eminent characters, who having secured by their discoveries or their doctrines the most essential advantages to their country and to mankind, have by the same labours obtained immortal fame to themselves, and to the place of their education and residence. Yet in the midst

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of applauses so justly deserved, the neglect of the study of Medicine in this place has caused much serious concern to our warmest friends, and afforded matter of severe reproach and animadversion to some, who from misinformation or misconception have entertained prejudices against us. But the munificence of our late much honoured and much lamented * CHANCELLOR, and the assiduity of the able Physician, whom the University has elected to the Clinical Chair, give us room to hope, if the liberal and truly noble design of our illustrious Patron, and the attentive exertions of his first Professor are supported and encouraged by a correspondent zeal in the individual members of this place, that the period is at last arrived, when all these causes of censure on the one hand and regret on the other will be totally obviated and removed.

Sensible as I am of my own inability to execute the task, which I have undertaken in such a manner as to lay claim to public approbation, I can only presume to recommend my design to the candour of the Uni-

* See an extract from the will of George Henry, Earl of Litchfield at the end of a Sermon preached by the present Lord Bishop of Bristol before the Governors of the Radcliffe Infirmary, in July 1779.

verfity, and to hope that the goodnefs of the intention will plead with prevailing influence in atonement for the defects and even imperfections, which will be found both in the plan and execution of thefe Lectures.

How great thefe defects and imperfections muft unavoidably be, will occur to every one, who confiders the almoft infinite extent of the Science, and the difficulty of purfuing a feries of experiments, amidft the interruptions and avocations of a Profeflion, of which the effential duties often require immediate attention.

The difficulties, which attend a Lecturer in this branch, will appear in a conspicuous light from a review of the extent and utility of the Science: but before I enter upon this difcuffion, it may not be improper to define what Chemistry is, and to point out its objects.

It is not eafy to draw up a definition of Chemistry, which will be intelligible to thofe, who are entirely ignorant of the Art, as might be made to appear from an examination of thofe definitions which have been advanced by the moft popular writers in this Science. I fhall only felect two, thofe of Macquer and Boerhaave.

The former thus introduces his Elements of Chemistry, “ To feparate the different

purpose of giving the necessary information, to a person unacquainted with the art itself. His Commentator on this account, who from his eminent knowledge could not but observe this defect, is obliged to conclude, that arts can never be justly defined, 'till their nature, extent, and uses are fully known: a true scientific definition being nothing more than a general truth or expression summing up or including all the particulars, from whence it was derived*. It is observable indeed, that when eminent Artists or Philosophers attempt to draw up a concise definition of the art or science to which they have devoted their studies, having a perfectly clear view of every part of the subject, they are apt to accommodate their definition to their own comprehensive knowledge and capacity, rather than to the uninformed minds of those who are to be instructed by them.

On these accounts it may be useful to take a more extensive survey of the science of Chemistry, and to illustrate its object by comparing it with others to which it is nearly allied.

“ The Properties of Bodies make the
“ objects of two sciences, commonly called

* *Shaw's Boerhaave ub. sup. Note, a.*

“ *Natu-*

“ *Natural Philosophy* and *Chemistry*, which
“ are indeed in many parts so interwoven,
“ that perhaps no boundaries can be estab-
“ lish’d between them. Yet in most cases
“ they certainly admit of an essential and
“ important distinction. *Natural* or *Me-*
“ *chanical* Philosophy, as it should perhaps
“ be named with more propriety and accu-
“ racy, seems to consider bodies chiefly
“ as being entire aggregates or masses;
“ divisible into parts, each of the same ge-
“ neral properties as the whole; and as being
“ of certain magnitudes or figures, known
“ or investigable, gravitating, moving, re-
“ sisting, &c. with determined forces, sub-
“ ject to mechanic laws, and reducible to
“ mathematical calculation. *Chemistry* con-
“ siders bodies, as being composed of a
“ particular species of matter, dissoluble,
“ liquefiable, vitrescible, combustible, fer-
“ mentable, and impregnated with colour,
“ smell, taste, &c; or consisting of dissimilar
“ parts, which may be separated from one
“ another or transferred into other bodies.
“ The properties of this kind are not subject
“ to any known mechanism, but seem to be
“ influenced by laws of another order. Thus
“ *Natural Philosophy* investigates the ob-
“ vious external and general properties of
the

“ the Air, Fire, Water, Heat, Cold, Moi-
 “ sture, Wind, &c. by various experiments,
 “ made with the air-pump and other suit-
 “ able instruments: but it is the business
 “ of philosophical Chemistry more intimately
 “ and essentially to examine the internal na-
 “ ture, structure, composition, operations, and
 “ relations of these Elements; and thence
 “ it finds modes of applying them as en-
 “ gines and instruments of business either
 “ separately or in co-operation with those
 “ solvents or menstrua, which have always
 “ been consider’d peculiarly as chemical
 “ agents *.”

This illustration, which points out the
 exact limits of these two branches of
 science, and particularly shews, that in the
 passage above cited from M. Macquer, Che-
 mistry is but partially and imperfectly de-
 fined, will serve also to introduce a Definition
 more accurately correspondent to the princi-
 ples of distinction here laid down.

A celebrated Professor in a Northern Uni-
 versity defines Chemistry to be a *Science,*
which teaches by experiments the effects of
heat and mixture on bodies: a definition,
 which will be found more truly applicable

* *Lewis, Comm. Phil. Tech. Preface.*

and comprehensive, than any which has hitherto been proposed.

The extensive utility of the science thus defined, is shewn by its immediate connection with almost all the arts in any degree subservient, not only to the comfort, but almost to the very subsistence of civilized life. In that important business of making bread; in the arts of dying, tanning, painting; in the manufactures of glass, porcelain, and enamel; in the preparation of artificial stone, and the various kinds of cement; the imitation of gems; the preparation and refinement of salts and sugar; the extraction of metals from the ore; the invention of compound metals, and the discovery of the several modes by which metallic substances may be applied to mechanical, culinary, or ornamental uses; the influence of Chemistry is sufficiently obvious. To the same source we may impute many of the principal improvements of modern Agriculture, the regulation of the putrefactive process for the preparation of manure, the investigation and detection of the beneficial qualities of alkalis, neutral salts, and some species of earth. These advantages are seen in a more extensive

view, when we contemplate the numerous products obtained in the different processes of distillation and fermentation. In this enumeration of the benefits, which have been introduced into civilized life by Chemistry, it would be unpardonable in one who proposes this course of lectures, as part of a plan for the promotion of the study of Medicine, to omit the mention of the great improvements, made by its union with Chemistry, both in the theory and practice of that Science. The nature and design of this undertaking will apologize for a more extensive excursion on this part of the subject.

Many of our most active Medicines are chemical preparations, equally unknown to the ancient inhabitants of Europe, and to the modern possessors of the uncivilized parts of the globe. The acquisition of these medicines, the display of their virtues, and the application of these properties to the relief of the calamities or infirmities of human nature, we owe entirely to the perseverance of the Chemical sect of Physicians. Their adversaries, who could not deny their pretensions to discoveries of such indisputable importance, contented their malice by ascribing these great proofs of indefatigable labour, in some instances directed by real genius,

nus, to accident and the favour of fortune alone : not recollecting, that even accidental discoveries are not made in Chemistry without almost incessant attention and fatigue. These inquiries, especially when the sphere of the application of this science became enlarged, required, if I may use the expressions of a very elegant Writer on this subject *, “ an uninterrupted attention of mind, “ and the constant wearisomeness of bodily “ labour :” and these artists perhaps thought themselves in no small degree successful, if their exertions of mind and body were even casually rewarded by a discovery, which might ultimately contribute to the advantage of mankind.

By the experiments of the Chemists we have obtained a more accurate idea of the formation, composition, and qualities of the blood and the secreted fluids of animal bodies. By the same we have acquired a more intimate knowledge of the process of respiration, and of the nature of the fluid discharged from the lungs with the breath : and thus the physiology and pathology of an organ so necessary to life have been greatly improved. By the progressive advancement of Chemistry,

* *Watson*, Essay I. Vol. I. p. 40.

Pharmacy, a most essential branch of the medical art, as it directs the preparation and composition of natural or artificial substances for medicinal purposes, has already received, and daily receives, proportionable illustration and advancement; and in this country especially has been rescued from a state, which was a scandal to the good sense of a nation, where the liberal arts were cultivated, and is now reduced to a judicious, concise, and elegant system *. To these observations we may add, that by the application of Chemistry we are making a daily progress in the investigation of the causes of epidemic diseases; and as we advance in the knowledge of their causes, it is but reasonable to hope we shall gradually discover and bring to perfection those means, by which their violence may be mitigated, and perhaps their frequent recurrence prevented. These diseases often spread devastation thro' extensive countries, over people of all ranks and orders, without being in their own nature infectious. That they cannot be imputed to any particular mode of living is obvious, because in those who are attacked with the evil, the mode of life is infinitely various. There must

* *Gregory, Comp. View, Vol. I. p. 127.*

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therefore exist some more general cause, most probably impregnating or influencing the atmosphere, which alone is common to all ranks of people. For a long series of years observations have been made on the sensible qualities of the atmosphere, relative to its weight and temperature; and these have been compared with the recurrence of epidemic diseases, but still we have not obtained a complete explanation of the phenomena. The inquiries of modern Chemists have been directed to the examination of its more hidden qualities, by an analytic investigation of its constituent parts*. The progress which has been made in this new path promises much real, much applicable information on a subject most immediately connected with the preservation of the first of all blessings, Health.

If after this survey of some of the principal circumstances, which have contributed to the convenience and elegance of domestic life in the European, and some of the Asiatic nations, we turn our thoughts to the contemplation of the miserable state of the uncivilized tribes, who reside in the interior regions of North America, Tartary, or the

* See *Bergman's* Preface to *Scheele's* Treatise on Air and Fire, *Forster's* translation P. xxi.

new discover'd islands in the South Seas, where these sciences and all their advantageous effects are unknown, we may be taught by the contrast to value and to cherish those arts, from which our superiority in civilization has been derived, and excited to use our utmost endeavours to transmit them down to our posterity with improvement, and to communicate them to nations yet uninformed, that the benefits which we enjoy may become universal.

While Chemistry has contributed so largely by the invention of these subordinate arts to the more commodious subsistence of the human species, it has lent its aid in many inquiries of a more important nature, which have contributed most essentially to the propagation of happiness by diffusing wide the instructions of History and the consolations of Religion.

It may be remarked, that to the use and application of glass in the construction of telescopes, mirrors, and optical instruments we owe the enlargement of our ideas concerning the Author of nature, and those stupendous laws, which regulate the system of the Universe, so perspicuously displayed by the sublime discoveries of Galileo and Newton. Thus the sciences of Astronomy and

Optics

Optics have been, and not remotely, indebted for their present eminent advancement to the labours of Chemistry. But in this place I more particularly allude to the inventions of Writing and Printing. The materials, by which these arts are carried on, are obviously of chemical production, and their progressive improvement to their present state of perfection has been derived from the same source.

Some writers fond of maintaining paradoxical opinions, and lamenting the vices of their own times, which even Learning has been too often prostituted to encourage and foment, have expatiated with rapture on the happiness of those ages, when the use of letters was unknown. They have supposed, that the contagious influence of vicious example, if it existed at all, acted but in a small sphere, and soon expired from the defect or absence of those corrupt sources of supply, by which it has been propagated in later periods and in modern states, which we affect to call civilized. But it is probable from a more intimate acquaintance with the real condition and modes of life of those numerous *bordes*, which reside in the interior regions of Tary, and America, that all these ideas of
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the existence of a pure morality in countries, where the use of letters is unknown, exist only in visionary and enthusiastic imaginations. The defects of traditional knowledge, the only species which can be conceived to subsist in such a state, are visibly displayed in those wild inventions, which disfigure the early pages of ancient history; where religion and impiety, morality and vice, are blended together in the most absurd fictions, and every excess and extravagance is countenanced, recommended, and enforced by the example of Heroes and Deities.

By the arts of Writing and Printing all the refined pleasures of social life have been advanced to the highest pitch of improvement. It will naturally occur to a reflecting mind, how much the important interests of Religion have been extended and secured by these arts, as by the multiplied copies of the Sacred Writings, the history of Revelation, the sublimity of its doctrines, the purity of its precepts, the consolation of its rewards, the terror of its judgements, have been propagated to the most distant regions, and perpetuated to all ages. We may add too, that by these means also have the elegant productions of genius in former periods been
deli-

delivered down to us; and thus we are taught to feel a portion of that inspiration which animated the sages and poets of antiquity. And even those persons of more obscure station, to whom the philosophic, historic, or poetic page of antiquity has never been open'd, will still acknowledge the extensive utility of the arts we are now contemplating, when they recollect, that by these the negotiations of trade are conducted, and that to these we owe the inestimable satisfaction, which arises from a reciprocal communication of the sentiments of friendship in epistolary correspondence.

The Chemical arts indeed have in a most essential manner contributed to the promotion of Navigation and Commerce. Thus the secret treasures of distant nations have been laid open and interchanged; the poverty of one country has felt the beneficial influence of the fertility of another; the stores of the *Materia Medica*, the means of preserving or restoring health, have been enlarged, and every comfort of domestic life has received ample augmentation. And in this general circulation of benefits, Chemistry has itself experienced a proportionable increase of its resources in a large supply of materials for future operations, from whence

new and unexpected products are daily obtained, and successive improvements in various manufactures and in medicine suggested and promulged.

While Chemistry has thus brought to light, and advanced to perfection, those various inventions, by which human life is render'd more commodious and more polished; it has pointed out the means, by which these advantages may be render'd secure to the possessor, and defended from the unjust invasions of avarice and tyranny.

The natural passions of men, inflamed by ambition or stimulated by necessity, in very early times taught the use of Arms. It is most probable, that the weapons of offence or defence, employed in the early ages, were no less rude than those, which are now used by nations little advanced in the arts of civil life. But the discovery of a method of extracting iron from its ore, and forging instruments of greater strength and execution, very soon superseded these rude inventions.

It is not my business to enter into a history of the art of war. It is a melancholy detail of transactions, which shew on the one hand the dreadful effects, resulting from the violence of unrestrain'd ambition, and the indulgence of malignant passions; but on
the

the other hand exhibit wonderful examples of intrepidity, patience, perseverance, generosity, and every other sublime virtue. This art, which the discovery of iron contributed only to render more extensively calamitous, was by another chemical invention reduced to a milder system. The use of Gunpowder has totally changed the mode of conducting war, and at the same time, that it has render'd policy and conduct more prevalent than brutal courage, it has contributed greatly to mitigate and soften this scourge, so destructive to the human race. Battles are now rarely distinguish'd by that dreadful carnage, which stained the plains of Cannæ and Pharsalia: and the influence of a milder Religion having inspired a milder system of morals, war has been converted, amongst civilized nations, by all these concurrent causes from an offensive to a defensive institution *.

* Dr. *Lettſom* in his learned and very entertaining history of the Origin of Medicine, mentions amongst other causes, which prevented the progress of Surgery in the early ages, that no attention was then paid to captives in battle tho' wounded, who were consider'd as the slaves of the conqueror. He gives many instances of this inhuman mode of treatment, and particularly remarks, that an exchange of prisoners was never thought of: "so that "one of the most likely means," he adds with equal sensibility and discernment, "of promoting the knowledge of

From the whole of this review of the advantages derived to mankind from the improvement of the science and art of Chemistry, (in which however many particulars have been but lightly touched, and many entirely omitted,) it will appear how much this science and the arts dependent upon it, have contributed to the civilization of life. And at the same time that it has made it more commodious and more desirable, it has supplied the means of protection and defence, whereby nations, and every individual possessor of these blessings, are enabled in peace and security to maintain their possessions inviolate.

THIS display of the infinite advantages, which mankind have derived from Chemistry, cannot but excite a curiosity, in those to whom they are displayed, to learn the steps by which the science has gradually advanced to that perfection, which it at pre-

“ Surgery, and the offices of humanity, was thus in a
 “ great measure precluded. Indeed the mode of making
 “ war among the ancients was no less inhuman than fatal.
 “ It is the invention of fire arms, that hath prevented the
 “ destruction of the human species, and at the same time
 “ contributed more to the establishment of science, than
 “ any discovery except the mariner’s compass.” *Lettson’s*
 Oration on the origin of Medicine p. 37.

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sent boasts. I shall therefore in the next place give as brief an account as I can of the principal events and revolutions in its history.

THE ancient history of Chemistry, like that of nations, is involved in obscurity, and perplexed with fabulous inventions. The lovers of this science, impressed with a high sense of its importance, have deemed its existence and cultivation co-eval with mankind. Some of its most sanguine votaries, not finding in the annals of those early periods traces of general knowledge adequate to discoveries of so sublime a nature, have attributed its invention to the immediate interposition of the Deity, and ascribed the operations of Tubal-Cain, (who, as we are told in Scripture*, distinguished himself soon after the fall of man by his works in brass and iron,) to direct inspiration from Heaven. The ancients, they say, sensible equally with themselves of the extent of his skill in metallurgy, so far exceeding that of all his contemporaries or predecessors, conceived him to be one of the Gods, and paid him divine honours under the name of

* Genesis iv. 22.

Vulcan*. It must be confess'd, that the extraction of iron and copper from the ore

* Nor was this the only mode of inspiration, by which this art was supposed to have been first communicated to mankind. Many of the alchemical writers have asserted that when the Dæmons, the fallen Angels, saw the daughters of men, they were enamour'd of their beauty, and obtained the gratification of their desires, by revealing to them the doctrines and processes of this *sacred* art. The curious reader will find in *Dr Shaw's* Edition of *Boerhaave's* Chemistry, V. I. p. 8. a satisfactory abstract from the writings of *Zosimus*, *Clemens Alexandrinus*, and *Borrichius* relative to this extraordinary subject. Frivolous and absurd as this opinion may now perhaps justly be thought, we are obliged to it for some very beautiful passages in the *Paradise Lost* and *Regained*; particularly B. 3. 463, B. 5. 446, B. 11. 580, and 613, and *Par. Reg.* B. 2. 175. In some of these passages Milton adopts the tradition of an intercourse between the fallen angels and the daughters of men: in others he confines himself strictly to the more plausible interpretation of that text of scripture, which has been made the basis of these strange conjectures (see Gen. 6. 2.) It is most probable, that by the appellation of the *Sons of God* were designed a select race of men, the descendants of Seth, who for a time preserved themselves pure and uncorrupted worshippers of the true God; but were at last seduced to idolatry by the alluring beauties of of the daughters of Cain.

The history of Vulcan is not less obscure and difficult of explanation, than that of the other heathen deities. *Borrichius*, unable to reconcile the various doctrines advanced on this point, is obliged to assert, that there were four persons of this name, who were deified by the ancients. 1st the Tubal-Cain of the Scriptures. 2dly Canaan, the youngest son of Cham, whose elder brother Mizraim he supposes to have been the Hermes or Mercury of the Egyptians. 3rdly a son Jupiter and Juno. 4thly a person of much later date, by birth, if I recollect right, a Mænalian, and afterwards king or lord of the isles, from him
called,

is, even at present, one of the most difficult operations of metallurgic Chemistry: and hence we are reasonably led to form no mean ideas of the skill of the artificer, who first effected

called, Vulcanian. He readily gives up Tubal-Cain, and supposes, that all the attributes and qualities, generally ascribed by the heathen world to Vulcan, should be referred to Canaan, whom he attempts to prove the Ægyptians regarded as the God of Fire. From the instructions of himself and his brother Mizraim, he informs us, they derived all their knowledge in Chemistry and Natural Philosophy, which he is willing to insinuate was so extensive, that subsequent discoveries have added little to it. Hermes the second, whose Ægyptian title, expressive of his greatness and knowledge, the Greeks translated Trismegistus, was posterior to these, and derived his celebrity from the illustration of the works of the first Hermes, and the wholesome laws and institutions, which he enacted. In defence of the erudition of the Ægyptians Borrichius is so strenuous an advocate, that he will not relinquish the smallest point to his opponents. His arguments, tho' perhaps they may not convince, may very much amuse, an inquisitive reader. See his work *De ortu. et progr. Chem.* p. 50 to 76. edit. Hafniæ. 1668. I cannot conclude this subject without observing, that whatever foundation there may be for any of these opinions concerning Vulcan; that which contends for the identity of this Deity and Tubal-Cain has scarcely any other support, than a slight resemblance, in some languages, in the sound or termination of the two names. The story of Vulcan, whoever was the person who acquired the honour of an apotheosis under that title, or whether any such person ever existed or not, seems to have some connection with the traditions concerning the War in Heaven and the expulsion and fall of the Rebel Angels. Homer in the first Iliad represents him, advising Juno to appease the anger of Jupiter by submission and acquiescence from his own experience of the dreadful effects of the excited wrath of that Supreme Power: and he then describes his expulsion from
heaven,

this laborious process. Our opinion of this difficulty, and consequently of the great extent of Tubal-Cain's knowledge, is farther increased by a doctrine, which still prevails in many works on metals and minerals, "*mineralia tendere ad metalla, metalla ad perfectionem*;" that is, that all mineral substances are in a progressive state, advancing from the most crude and imperfect mineral, earth or stone by the gradual operation of nature to a metallic form, and still onwards thro' the less perfect forms of metals to the condition of that, in which all the distinguishing qualities are united, Gold *. This

heaven, when on a former occasion, either in defence of herself or some other Deity, he had dared to oppose the authority of Jupiter, which none ever resisted with impunity.

Μητρι δ' εγω παραφημι, και αυτη περ νοεσση
 Πατρι φιλω επιηρα φερειν Διι, οφρα μη αυτε
 Νεικειησι πατρης, συν δ' ημιν δαυτα ταραξη·
 Ειπερ γαρ κ' εδειλησιν Ολυμπος αεροπητης,
 Εξ εδρων συφελιζαι· ο γαρ πολυ φερτατος εστιν.

Iliad. α. 577.

And below :

Τετλαθι, μητηρ εμη, και ανασκειο κηδουμενη περ,
 Μη σε, φιλην περ εεσαν, εν οφθαλμοισιν ιδωμαι
 Θεινομενην· τοτε δι' εστι δυνηστομαι, αχθυμενος περ,
 Χραιοσμειν· αργαλειος γαρ Ολυμπος αντιφερεωδς.
 Ηδη γαρ με και αλλοτ' αλεξιμεναι μεμαωτα,
 Ριψε, ποδος τεταγων, απο βηλε δεσποεσσιο.

Id. 586.

* Traces of this doctrine are to be found in almost all the alchemical writers, whose works are intelligible: but
 I deem

opinion was dictated by an attachment to the theories and pursuits of alchemy; and is perhaps more agreeable to these than to truth and nature. If this alchemical doctrine were true, specimens of native metals or even of metals in the various stages of their progressive state would not be such rare occurrences as they are. I am induced to believe, that the inverse of the abovementioned position is the truth; and that metals were in the earlier ages much more fre-

I deem it needless to refer to these, when I can produce the authority of much later and more perspicuous chemists. See *Beccheri* Supplement. Secund. in *Physicam Subterraneam*, Thesin 2ndam, de subiecto transmutationis metallicæ. “Præcedens thesis demonstravit possibilitatem et
 “necessitatem transmutationis metallicæ; nunc hæc thesis,
 “qualiter illa contingat examinabimus, atque ita de sub-
 “iecto transmutationis metallicæ agemus. Cum vero
 “natura semper intendat perfectius, etiam illam suum or-
 “dinem circa transmutationem metallorum observare cre-
 “dibile est. Statuemus ergo, naturam omnia corpora
 “metallica in aurum deducere velle; etiam deducturam,
 “si non impediatur.” &c. &c.

See also *Stablii Specimen Beccherian.* Part. I. Sect. II. *Memb.* 4. *Thes.* 4. where the doctrine is carried much farther, and extended to all subterraneous bodies, the thesis proposed being, “*Subterranea tendunt ad metal-*
 “*licitatem; metalla ad perfectionem.*” The defence of this thesis begins thus, (by which we perceive that *Stabl* did not entertain a doubt concerning the truth of the position.) “*Est hæc authoris nostri hinc inde indigitata asser-*
 “*tio; cui sicuti velut universa alchymistarum antiquitas*
 “*pollicem premit.*” &c. &c. &c. Though he afterwards makes some attempts to modify and limit the doctrine.

D

quently

quently found native, or very rarely and slightly combined with those substances, with which we now find them mineralized, and which render the extraction of them from the ore so difficult. When we consider how many solvents of metallic substances are every where presented in the bowels of the earth, and reflect how soon any of the metals, except gold, silver, and platina, exposed to the action of subterraneous steams and vapours, are corroded and even dissolved, we shall rather imagine, that we see nature acting in an opposite mode; and be led to suppose, that metals were originally formed in a state much nearer to that which we call perfect, and that their purity has been gradually diminishing by the action of those substances, which are now the media of their mineralization. If this opinion can be admitted, the works of Tubal-Cain may be deemed less difficult, than upon the common supposition we have been induced to believe them.

From this inspiration of the first artificer in chemical works, whose name stands upon record, the art, if we believe the suggestions of partiality and enthusiasm, advanced quickly to the utmost degree of perfection in the antediluvian world: And the valuable secrets,

secrets, which its numerous professors and votaries had revealed, were preserved with anxious care by the sons of Noah, when every trace of other sciences was obliterated in the universal calamity of the deluge, and were particularly cultivated and taught to his descendants by Cham, whose posterity settled in Palæstine and Ægypt. * From him, it is asserted, the name of the art itself *Chamia* or *Chemia* is derived. The proverbial celebrity of the Ægyptians in general science, and in many of the arts immediately connected with Chemistry, in dying, gilding, in some metallic works, and in the embalming of bodies, † seems to give a good

* Hist. de la Philosoph. Hermet. par. L'Abbé Lenglet du Fresnoy. Vol. I. p. 7. Sect. IV.

† Allusions to the wisdom of the Ægyptians, and proofs of their proficiency in these arts, at least in the time of Moses, are very frequent in the Old Testament, particularly in the following passages. *Genes.* 41. v. 42. *Id.* 50. v. 2, 3, 26. *Exod.* 25. v. 11, 31, 36. *Id.* 28. throughout. *Id.* 12. v. 35. *Id.* 31. v. 3, 4, 5. *Id.* 32. v. 4. *Id.* 35. throughout: to which may perhaps be added 1 *Kings.* 4. v. 30.

To these testimonies concerning the skill of the Ægyptians we may add that of Homer, tho' it must be acknowledged, that according to every system of chronology some hundred years elapsed between the times of the patriarch and the poet, yet the passage shews, that many of the ornamental arts connected with Chemistry had been long practised in Ægypt. The passage I allude to is the account of the presents made to Menelaus and Helen by the king of Thebes and his wife, consisting of elegantly

foundation for such an opinion. An argument supposed irrefragable in confirmation of these conjectures is adduced from the scriptural account of the destruction of the golden calf by Moses, who is expressly said, * to have been learned in all the wisdom of the Ægyptians. Much time and much learning have been expended very fruitlessly on the illustration of this piece of sacred history. It has been generally produced as a demonstration of the flourishing state of Chemistry in Ægypt, as it is thought to prove, that they were not unacquainted with the method of dissolving gold. But it has been justly remarked, by a very elegant and ingenious Writer, § that the expressions of Scripture, in either of the passages, where this fact is recorded, † do not authorize us to

wrought vessels of gold and silver. *Odyf. d. 125 et seq.* Perhaps in many of these passages, the terms properly understood will not be thought to imply such an extensive and universal knowledge of Chemistry in Ægypt, as the advocates for this opinion are willing to suppose. Conjectures might be advanced on this subject, but I think it better to let these descriptions have their full force. Yet it may be observed, that in all these passages or the books from which they are taken, we find very rarely any mention made of iron or brass; from whence it should appear that the operations on these metals were not brought to any great perfection. The accounts too of their dying and colouring are extremely general.

* *Acts* 7. v. 22.

§ *Watson's Chemical Essays*. Vol. I. p. 10.

† *Exod.* 32. v. 20. *Deuteron.* 9. v. 21.

say, that Moses made an actual *solution* of the gold. We are simply told, “ that he
“ took the calf, which they had made, and
“ burnt it in the fire, and ground it to pow-
“ der, and *strawed it upon the water*, and
“ made the children of Israel to drink of it.”

And secondly, supposing the solution to have been as perfect, as could have been effected by the process of Dr. *Stahl*, which some have called in to their aid, is it in any degree a proof of the general proficiency of the Ægyptians in Chemistry, that One Man, distinguished by the peculiar favour of Heaven, and led by the visible hand of the Deity ; One, who had not long before, to discountenance and counteract the rebellious disposition of his tribes (by giving evidence of the supernatural powers, with which the Almighty had endued him) divided the sea for their passage, and called forth water from the rock to relieve their thirst ; that this One Man should effect a phænomenon, to them perhaps equally new and extraordinary, the solution of gold ? Is not the very mention of it rather a proof, that it was effected by no process generally known, by no common power or knowledge ?

We may leave therefore to the Ægyptians, and their neighbours the Tyrians and Phæ-
nicians,

nicians, the credit of the arts for which they are so celebrated : we may even permit the vanity of antiquarians in science to expatiate on the inventions of the fabulous ages, the discoveries of Hermes, and the wonderful Arcana revealed only to those who were initiated in the Ægyptian mysteries ; but with all reasonable indulgence to their credulity, we cannot allow these ideal fancies to usurp the place of truth. It will appear most probable, if we attend with due discrimination to the few authentic evidences which can be collected from ancient history, that Chemistry (tho' many of the arts dependant upon it were not unknown to the antediluvian world, to the Ægyptians and Tyrians since that period, and still more lately to the Greeks and Romans) was little more than a collection of some few processes, necessary to life or subservient to luxury ; but was never considered in one comprehensive view, or cultivated as a science, previously to those ages, which we deem modern. The ancients probably knew not even the name of Chemistry, tho' so much has been written concerning the word *χημεία*, which seems rather to have been derived from the name of a district, or perhaps of the whole of Ægypt applied originally from some peculiar
appear-

appearances of its soil, and borrow'd afterwards at a very distant period of time to distinguish an art, which was conceived to have had its rise and principal cultivation in that country. Plutarch calls Ægypt, *χημια*, * but without any reference to the arts for which it was celebrated. It may be added that we find no clear allusions to it in the classical authors, tho' its doctrines and discoveries would have afforded ample scope for the exercise of the faculties of the imagination, and the powers of description. From all that has been advanced concerning the rise and progress of Chemistry, perhaps it may be thought not unreasonable to believe, that the art owes its origin to the necessities of mankind in the earliest ages. Some painful or pleasing impression, excited by surrounding objects, called the attention of men to the examination of the properties of particular bodies, which chance had presented: and the sense of some craving want suggested the means of applying those properties to use. It was very long however before the stock of chemical facts. thus slowly accumulating, afforded materials for

* ΕΤΙ ΤΗΝ ΑΙΓΥΠΤΟΝ ΕΝ ΤΟΙΣ ΜΑΛΙΣΤΑ ΜΕΛΑΓΓΕΙΑΝ ΕΣΑΝ ΩΠΩΣ ΤΑ ΜΕΓΑΛΑ ΤΕ ΟΦΘΑΛΜΟΙ ΧΗΜΙΑΝ ΚΑΛΕΣΙ.

Plutarch. Is. & Osir. Squire's Edit. Sect. 33.

that

that comparifon of facts and their relations, which we call Science. The principles of many branches of the art, and therefore thofe branches themfelves, are neceffarily co-exiftent with mankind; but the fcience of Chemistry was entirely unknown to the ancient world.

In purfuing this hiftory, I do not think it neceffary to detain you with an account of what has been related of the proficiency of Pythagoras and Democritus * in this art, particularly in the imitation of gems, with which the latter has been faid to have been intimately acquainted. It is not improbable, that by accident he had difcovered a procefs, by which a glaffy compofition might be formed, and had learned, equally by accident, a mode of tinging it of various colours. Even this degree of knowledge, if fupported by proper affiftances

* The *Abbé Lenglet du Fresnoy*, in his 1ft Vol. of the *Hift. de la Philof. Hermetique*, cites the following testimonies of the chemical knowledge of Democritus, “Itaque, inquit, omnium herbarum succos Democritus expreffit, et ne lapidum virgultarumque vis lateret, ætatem inter experimenta conſumpſit.

Petron. Arbitr in Satyrico.

Hic etiam doctiffimus fuit Democritus: primus enim liquandi lapides, fingendi ſmaragdos, et quemlibet infundendi colorem, rationes invenerit. Ebur emollire noverat, aliaque innumera.

Seneca Lib. 14. Epift. 91.

Du Fresnoy Hift. Vol. I. p. 29.

of

of mystery, which are rarely deficient in the philosophical experiments of rude and uninformed periods, would have attracted no small admiration, when the art was in its infant state. It is not easy to rely with much confidence on any accounts, which the ancients have given of his farther progress. The language of admiration is not always the language of truth, because admiration is often the offspring of ignorance.

The history of Chemistry affords but little instruction or amusement, 'till we come to the æra of ALCHEMY.

This is an Arabian title given to a most extraordinary science, by which it was supposed that a few persons, who from their wonderful acquisitions were called, *Adepts*, could transmute all metals into gold, could prepare an universal solvent, and compound a medicine, capable not only of restoring health, but even of perpetuating life.

The principal object of this Mania for many ages was the art of making gold. For a great length of time, it employed only the speculation of a few curious persons, so buried in retirement and lost in obscurity, that there is almost reason doubt, whether the persons, whose names are delivered down to us, ever existed. Some authors assert, that

so early as the third century of the Christian æra, the emperor Dioclesian issued an edict for burning all the books of the Ægyptians on this art, on account of some conspiracies formed against the Roman state. Tho' this edict is omitted by most of the writers, who have given us the history of that period, yet it is introduced into a late very celebrated work, principally on the authority of Suidas.* It is introduced however with caution and doubt, and with these just observations, that probably these ancient books so liberally ascribed to Pythagoras, Solomon, and Hermes, were the pious frauds of more recent Adepts; that there is no mention of the transmutation of metals in Pliny's voluminous register of the discoveries, the arts, and the errors of mankind; and that if Dioclesian had been convinced of the reality of this valuable art, far from extinguishing the memory, he would have converted the operation of it to the benefit of the public revenue. † Mr. Gibbon calls this celebrated edict, and the persecution of Dioclesian, the first authentic event in the history of Alchemy. "The conquest of Ægypt by the Arabs," he adds,

* *Suidas* in Voce *χημεία*.

† *Gibbon's History of the decline and fall of the Roman empire. Vol. I. Ch. 13.*

“ diffused

“ diffused that vain science over the globe.
“ Congenial to the avarice of the human
“ heart, it was studied in China, as in Eu-
“ rope, with equal eagerness and with equal
“ success. The darkness of the middle ages
“ ensured a favourable reception to every
“ tale of wonder, and the revival of learning
“ gave new vigour to hope, and suggested
“ more specious arts of deception.” Not-
withstanding an authority so respectable, I
am inclined to doubt, whether the doctrines
of Alchemy prevailed, that is, were so openly
advanced as this passage would imply, at
that period. I cannot absolutely prove, that
Dioclesian really did not issue such an edict,
or that the Ægyptians did not boast, that they
were possessed of this wonderful degree of
chemical knowledge; but it may be justly
thought extraordinary, that a circumstance so
important is not noticed by all the historians
of that and the immediately succeeding ages.
There are some reasons too, to suspect that
this famous passage of Suidas has been in-
terpolated by some later commentator or edi-
tor of that author, or that Suidas himself
(for he wrote, whatever system of chrono-
logy we chuse to follow concerning him, at
a time when the alchemical opinions flou-
rished in full vigour) adopted it, without

sufficient proof of its truth, from some of the alchemical writers, who had invented it to increase the dignity, by establishing the antiquity of their art. And we have the more reason to believe, that either one or the other of these suppositions is just, as Suidas or his interpolator goes much higher in another place, and asserts in express terms, “ that the golden fleece, which Jason and “ the Argonauts carried over the Pontic sea “ to Colchis, was only a book written on “ skins, which taught the manner of mak- “ ing gold by the chemical art.” * I only produce this passage as a proof of the credulity, or at least facility, with which Suidas introduced any alchemical assertion into his collection; for this opinion, whatever may be thought of the former, is so absurd in itself, and so destitute of any support from ancient history, from the works of the Græcian poets and philosophers, and so totally discountenanc’d by every system of mythology, that it can require no further comment. It is obvious however to remark, that these two passages of Suidas stand upon the same foundation: either they are both interpolations, or they were taken without

* *Suidas*, in Voce *Διδασκαλίας*.

sufficient examination of true history from the writings of the alchemists.

We are only certain, that in the dark ages, which accompanied and succeeded the decline of the Roman empire, the opinion of the possibility of a transmutation of metals into gold began secretly to disseminate itself. By the conquests of the Saracens, amongst whom or in their subjected provinces of Ægypt they seem first to have sprung, they were still more generally, tho' slowly, propagated throughout Europe : and in a later period, when a more frequent intercourse between the western and eastern nations took place in the Crusades, the Arabian enthusiasm found a stage for the most ample display of its influence in the minds of those visionaries, who, from the rude materials formerly imported by the Saracen conquests and the establishment of their schools in Spain, &c. had speculated much on these dark subjects. It was now the æra of romance and enthusiasm. This extravagant principle diffused itself thro' all orders of men : it appeared with equal prevalence in the courts of princes, in the camps of warriors, in public and domestic life, in every occupation and profession, in the lowest drudgeries of trade, and the sublimest duties of Religion.

gion.* It is not therefore to be thought wonderful, that it incorporated itself so intimately with the speculations of the alchemists, to which it was so naturally allied. They immediately conceived themselves to be philosophers of a superior order. They

* There are many proofs of this position in Mr. *Warton's* Hist. of English Poetry, particularly in his dissertations. The following passage is much to our purpose, and may be applied to philosophical studies, with no less propriety than to poetical composition. "It is an establish'd
 "maxim of modern criticism, that the fictions of Arabian imagination were communicated to the western
 "world by means of the crusades. Undoubtedly those
 "expeditions greatly contributed to propagate this mode
 "of fabling in Europe. But it is evident, although a
 "circumstance which certainly makes no material difference as to the principles here established, that these
 "fancies were introduced at a much earlier period. The
 "Saracens or Arabians having been for sometime seated
 "on the northern coasts of Africa, enter'd Spain about
 "the beginning of the eighth century. Of this country
 "they soon effected a complete conquest: and imposing
 "their religion, language, and customs upon the inhabitants, erected a royal seat in the capital city of Cordoua. That by means of this establishment they first
 "revived the sciences of Greece in Europe, will be proved at large in another place: and it is obvious to
 "conclude, that at the same time they disseminated those
 "extravagant inventions, which were so peculiar to their
 "romantic and creative genius." * * * * *
 "The ideal tales of these eastern invaders, recommended
 "by a brilliancy of description, a variety of imagery, and
 "an exuberance of invention, hitherto unknown and unfamiliar to the cold and barren conceptions of a western
 "climate, were eagerly caught up and universally diffused."

arrogated

arrogated to themselves a title of distinction, and prefixing the arabic particle, expressive of preeminence, to the name of their favourite pursuit, they called their art, *Al-Chemia*, themselves *Al-Chemistæ*. They fancied strange analogies between the most remote parts of the universe, as if all nature was subject to alchemical laws. Hence they discovered in the properties of metals, a fancied resemblance to the influence of an equally imaginary emanation from the Sun and the Planets. On this presumption they assumed the ancient astronomical characters, as the marks of metallic substances; and applied to gold the hieroglyphic of the Sun, to silver that of the Moon, that of Jupiter to tin, of Mars to iron, of Saturn to lead, of Venus to copper, and of Mercury to quicksilver.* That they might insinuate, that the knowledge of their mysteries was permitted only to a few, and not attainable by the vulgar, they affected to call those to whom these valuable secrets were compleatly revealed, *Adepti*. Van Helmont says, *Adepti, quorum etiam rector Spiritus Dei est*; a sentence,

* As this position concerning the use of characters in Chemistry differs from that which is usually advanced, I have taken some pains in the second Tract to shew the principles upon which I have adopted it.

which

which may be thought sufficiently to express a peculiar discrimination of this class of men from all others, at least in their own vain imaginations, if it be allowed that he there particularly alluded to his own sect: but it is not easy to discover his true meaning through the obscurity of his language. * Indeed the works of all these authors are distinguished by a peculiar mysterious jargon, which conveys little instruction or amusement. It is somewhat remarkable, that their art, their writings, and even their names are veiled with an almost impenetrable cloud of darkness. As they assumed very often, for the sake of greater mystery, fictitious appellations, we are but imperfectly acquainted with the true names of most of them, the time when they lived, and whether the works generally attributed to them be genuine or spurious. Those who are curious to investigate these fabulous ages of science will receive much information, if it may be so called, from the works of Borrichius, (particularly his tract de Ortu et Progressu Chemiæ,) from the entertaining history of the Hermetic Philosophy by the Abbé Lenglet du Fresnoy*, and the preface

* *Van Helmont*, de magn. vuln. curatione, §. 129.

* It should be observed, that in this work, the learned Abbé seems to have confounded together those who cultivated

to Dr Shaw's edition of Boerhaave's Chemistry.

After all that has been said on this subject, it would be injustice not to acknowledge, that it appears consistent with the regular operations of the human mind, that men, conversant in metallurgic processes, and accustomed to see metallic substances assume a thousand various forms, should endeavour to extend those conversions, and hope to discover a mode of procuring from the most unpromising the most beautiful and the most precious of all these metals. The wonders, which they every day saw arise from their art, made them conceive hopes of adding this new prodigy to those, which they had already seen effected. They were not enabled by former experiments to judge concerning the possibility of their undertaking; and even now the question is in the minds of some Chemists not absolutely decided*. To condemn the first trials would be therefore unjust, and as we are happily relieved by a more enlightened philosophy from the absurd fictions, which obscured and disgraced their experiments, it would be ungenerous not to

tivated genuine Chemistry, and many who were only inquirers into the history of nature, with those who advanced pretensions to the knowledge of the grand Arcanum.

* Preface to the Chemical Dictionary. 4to Edit. p. v.

confess the obligations, which this science owes to their unremitting perseverance. Their example led men by degrees to that important change in the history of Natural Philosophy, when hypothesis and fiction gave way to experiment and observation. The extraordinary discoveries which they made, and the innumerable processes, which they themselves instituted or suggested to future operators in a more enlightened period, have contributed by various accidents to the perfect disclosure of many admirable secrets. In confirmation of this I need only mention their proficiency in Pyrotechny, or the invention of explosive and inflammable compositions, the preludes to the discovery and application of gunpowder. Of these we have a celebrated instance in the Feu Gregeois or Grecian Fire, so much spoken of by the Poets and Historians of the immediately succeeding ages, and particularly mentioned in the history of the Princess Anna Comnena, who lived in the beginning of the 11th Century *. It is described as a sort of

* Alexiad. Lib. 11. p. 336. and Lib. 13. p. 383. Edit. Hoefchel. fol. Paris 1651. This work is the history of the Emperor Alexius, the father of the fair historian, and has been deservedly celebrated, as well for its own internal merits and graces of composition, as for the piety and filial affection with which it is dictated. A work, which has
been

wild-fire, not easily extinguishable by water, and therefore much used in naval engagements, being thrown by the hand or by in-

been so highly complimented by the pen of Mr *Hayley*, requires no additional commendations from me : but I hope I shall be pardon'd, even by those who are most prejudiced against the impertinence of digression, and the parade of quotation in writings of this kind, for transcribing the following passage.

But while monastic night with gathering shades
 The ruin'd realm of history invades ;
 While pent in Constantine's ill fated walls,
 The mangled form of Roman grandeur falls ;
 And, like a gladiator on the sand,
 Props his faint body with a dying hand ;
 While savage Turks or the fierce sons of Thor,
 Wage on the arts a wild Titanian war ;
 While manly knowledge hides his radiant head,
 As Jove in terror from the Titans fled ;
 See ! in the lovely charms of female youth,
 A second Pallas guards the throne of Truth !
 And with COMNENA's royal name imprest,
 The zone of Beauty binds her attic vest !
 Fair star of Wisdom ! whose unrival'd light
 Breaks through the stormy cloud of thickest night ;
 Tho' in the purple of proud misery nurs'd,
 From those oppressive bands thy spirit burst ;
 Pleas'd, in thy public labours, to forget
 The keen domestic pangs of fond regret !
 Pleased to preserve, from time's destructive rage,
 A father's virtues in thy faithful page !
 Too pure of soul to violate, or hide
 The Historian's duty in the Daughter's pride !
 Tho base oblivion long with envious hand
 Hid the fair volume which thy virtue plan'd,
 It shines, redeemed from ruin's darkest hour,
 A wondrous monument of female power ;
 While conscious Hist'ry careful of thy fame,
 Ranks in her Attic band thy filial name,

struments from one ship to another in vessels, which broke by the collision, and discharged

And sees, on glory's stage, thy graceful mien
Close the long triumph of her ancient scene.

Hayley's Essay on Hist. Epist. 1. ad fin.

Mr *Hayley* has subjoined in his notes a more particular account of this extraordinary Princess, and a translation of the preface to her *Alexiad*. This History is printed in the voluminous collection of the Byzantine historians; but as few persons, who may condescend to peruse these tracts, may have opportunity, and fewer still inclination, to ransack those immense volumes for information concerning the Græcian Fire, it may not be useless to extend this note by adding a passage from Mr *Warton's* History of English Poetry, introduced by some lines of the old Poem of *Richard Cœur de Lyon*, wherein mention is made of the *Fyre Grekys*. “ This Fire Grekys or Græcian fire” says the very ingenious Historian “ seems to be a composition “ belonging to the Arabian Chemistry. It is frequently “ mentioned by the Byzantine Historians, and was very “ much used in the wars of the middle ages both by sea “ and land. It was a sort of wild-fire, said to be inextinguishable by water, and chiefly used in burning ships, “ against which it was thrown in pots or phials by the “ hand. In land engagements it seems to have been discharged by machines constructed on purpose. The oriental Greeks pretended, that this artificial fire was “ invented by Callinicus, an architect of Heliopolis, under “ Constantine; and that Constantine prohibited them from “ communicating the manner of making it to any foreign “ people. It was however in common use among the nations confederated with the Byzantines: and Anna “ Comnena has given an account of its Ingredients (see “ du Cange not. ad Joinvil. p. 71. and Gl. Lat. V. Ignis “ Græcus) which were Bitumen, Sulphur and Naphtha. “ It is called *Feu Gregois* in the French chronicles and “ romances. Our minstrel, I believe, is singular in saying, “ that Richard scatter'd this fire on Saladin's ships: many “ monkish historians of the Holy War, in describing the “ siege of Acon, relate, that it was employed on that occasion
and

their inflammable matter. Comnena informs us, that it was composed of Sulphur, and Bitu-

“ and many others, by the Saracens against the Christians.
 “ (see more particularly Chron. Rob. Brun. p. 170 and
 “ Benedict. Abb. p. 652. and Joinvill. Hist. L. p. 39.
 “ 46. 52. 53. 62. 70.) Procopius in his history of the
 “ Goths, calls it *Medea's Oil*, as if it had been a prepara-
 “ tion used in the forceries of that enchantress (Proc.
 “ iv. 11.” *Warton's Hist. of Eng. Poetry Vol. I. p. 157.*

The numerous references of Mr Warton concerning the Grecian fire would prevent any addition of mine, did - I not think it necessary to correct his citation from Procopius, and to subjoin one or two observations from other Authors. According to his representation, it may be thought, that Procopius calls the Græcian fire *Medea's Oil*, but he only says, that the Greeks gave that name to the Median Naptha. The passage is as follows,

Αγγεια δε θεου τε και Ασφαλτου εμπλησταμενοι και φαρμακον,
 οπερ Μηδοι μιν Ναφθαν καλουσιν, Έλληνες δε Μηδειας ελαιον,
 ουχι τε ταυτα οφαιδαντες, επι τας Μηχανας των κριων εβαλλον
 ας ολιγω εμπιμπρησαι πασας εδεντεν.

Procop. de Bell. Goth. L. IV p. 594. Ed. Hoeschel. Paris fol. 1651.

In the Translation of the passage from Procopius in this edition, the word φαρμακον is render'd by *venenum*, which is evidently improper, because Naphtha is described by many of the most respectable Græcian authors as possessing highly medicinal qualities, (see particularly *Dioscoridis* Ch. 86), *Venenum* is sometimes used in speaking of the substances employed in the embalming of bodies, but otherwise always in the bad sense, as a poison. φαρμακον is at least as often, if not more frequently, used in the good sense, than in the bad. Of this innumerable instances might be given (see the word in *Constantinus* or *Scapula's* Lexicon: the latter expressly says of it, Pro medicamento salutari Græci dictum volunt, qu. φερων ακος, ferens medelam, pro exitiali qu. φερων αχος, ferens tristitiam). *Suidas* likewise remarked, that the Greeks called Naptha *The Oil of Medea*; but his annotator *Kusterus* supposes his observation
 to

men, to which Procopius adds Naptha, but probably this part of the account is not exact.

To return to the more ancient Alchemists. Even in this crowd of writers there are some, who have expressed themselves with less obscurity than others, and in this number the University of Oxford has the honour of ranking one of her sons, one of the first Fellows of Merton College, *Roger Bacon* *,

to have been derived solely from the above cited passage of Procopius, (see Kusteri Suidas Vol. II. 602.) It is possible after all, that this bitumen obtained this title by a very easy mistake. As the name of the country from which it was imported, *Media*, bears a great resemblance to that of the celebrated Enchantress, *Medea*; it is very reasonable to imagine, that the vulgar, entertaining a high opinion of its virtues, might conceive, that it was derived from some præternatural source; and might regard it, not as a natural and common exsudation from the soil in the province *Media*, but as a composition invented by the extraordinary skill of the sorceress, *Medea*. See the article *Huile de Medie* in the *Encyclopedie*..

* The building, in which this celebrated Philosopher (according to tradition) resided, on the southern bridge over the Isis, having been lately taken down to enlarge and open that avenue to the city of Oxford, it may not be unentertaining to those, who think that such valuable monuments of Antiquity should not be so easily given up to the prevailing rage for novelty, under the specious name of improvement, to peruse the following passages concerning that edifice.

The Abbé *Lenglet du Fresnoy*, speaking of the persecutions, which Bacon underwent, adds “ Enfin soit ignorance, soit jalousie, comme il n’arrive que trop souvent
“ dans les communautés, ils le persécuterent en 1278,
“ et l’année suivante ils eurent le credit de le faire em-
“ prison-

who appears to have had a thorough acquaintance with many important operations in Chemistry, which we deem modern. Amongst

“ prisonner, et cet habile philosophe est obligé d’avouer,
 “ qu’il eut plus d’une fois lieu de se repentir d’avoir pris
 “ tant de peine à se perfectionner dans les arts et dans les
 “ sciences. Il fut même contraint d’abandonner la maison
 “ de son ordre, et de se former une retraite, où il travailloit
 “ plus tranquillement, et l’on assure, *que l’on montre toujours*
 “ *aupres d’Oxford une maison qui porte encore le nom de*
 “ *Frere Bacon*, qu’il avoit choisie pour ses études, et ses
 “ expériences.” L’Hist. de la Phil. Herm. Vol. I. p. 115.

To this observation he subjoins the following passage from Borrichius. “ Extat hodieque Oxonii *Domus Rogeri*
 “ *Baconis*, incolis The *House of Fraer Bacon* appellata,
 “ quam, cum ab altera Tamesis urbem lambentis ripa, mihi
 “ ostenderet Edmundus Dickinsonus, Medicus insignis,
 “ adjecit, Rogerium Monachorum quorundam obtrectati-
 “ onibus quotidie proscissum in ulteriori ripa fixisse sibi
 “ ædes.” Borrich. de Ort. et Prog. Chemiæ P. 118
 in 4to Hassniæ, 1668.

This celebrated mansion stood for many years uninjured by the assaults of time, or the still more violent efforts of zeal for innovation and improvements. So lately as the year 1773, an ingenious Bard attempted to console the admirers of antiquity with a vain promise of its eternal duration, which he could not conclude, but with a melancholy preface of the cause from whence its downfall would originate.

“ Dic age, num veteris restant vestigia portæ
 Nulla tibi? quid sacra ergo penetralia censes
 Quo spectanda modo, quâ nunc sublimis ad austrum
 Stat summo de ponte *Domus veneranda* BACONI,
 Relligione loci seros intacta per annos?
 Hoc tibi Palladium, nunquam de sede movendum
 Sacratâ, nisi quod via sat vicina molesta est,
 Heu Genti nimum, velut Appia, dura Togatæ.”

From an elegant and spirited Dialogue concerning the alterations in Oxford, spoken before Lord North and the University at the Encœnia 1773 by Richard Hely Hutchinson and David Henry Urquhart, Gentlemen Commoners of Magdalen College.

others, he thought to have had a perfect knowledge of the nature and composition of Gunpowder : yet the honour of this discovery, which has been the source of such surprizing revolutions in the history of the world, has been ascribed almost by universal consent to a monk, often erroneously called a Jesuit, of Goslar in Germany, *Berthold Schwartz*, who lived many years after. It is most probable however, that neither Bacon nor Schwartz were the original inventors of this composition. It is not impossible, that Bacon derived his acquaintance with it from his indefatigable examination of the Arabian writers, to the study of which he devoted no small part of his time and attention. This opinion seems to be confirmed by this circumstance, that the Moors in Spain were amongst the first persons, who employed gunpowder in war ; that they used it at the siege of Algeiras * eleven years before the date of Schwartz's discovery § ; and still farther, if we may credit the accounts of some historians of no mean character, that its use was known in Asia, and particularly in China, many years before the date of its employment in Europe †.

* 1343.

§ 1354.

† The Testimonies, by which this point must be determined, are all adduced by Dr *Watson* in his 10th Essay,

Independent of this point, it must be admitted, that Bacon was indisputably a man of no common talents ; and that it is wonderful, considering the ignorance of the age in which he lived, from what sources he obtained such extensive knowledge on all subjects. His writings, tho' frequently darkened with the jargon of alchemy, are composed in general with a considerable degree of elegance and strength, and abound with many excellent observations, perfectly consonant to the discoveries of later times in Chemistry and Natural History. *

To the name of Bacon very few others of that age can be added. With great study, and by the help of subsequent experiments, we have been able to discover, that they probably knew more than they wished to reveal ; but from their own writings we learn very little. Their knowledge is invelopped in mysterious language, and uncouth expressions, which are very frequent even in the writings of Bacon himself.

Essay, which expressly treats of the time when gunpowder was discovered. It is therefore needless to transcribe them, as that work should be in the possession of every one who is studious of Chemistry.

* See Dr *Freind's* account of the life and writings of this extraordinary man in his history of Phycic.

Freind. Op. Omn. folio. p. 537, et seq.

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A more

A more particular account of these writers, and a list of all the alchemical authors, supposititious or real, is given in the preface to Dr Boerhaave's Chemistry, and the notes of Shaw. *

* The sentiments advanced above concerning Alchemy in general, the character of the Alchemical authors, and particularly the doctrine of the transmutation of metals, are the result of an attentive examination of almost every work, that has been written intelligibly on this subject, in none of which has any thing appeared tolerably plausible in support of these pretensions. Vague empirical assertions or hypotheses, unsupported by argument or experiment, disguised under an impenetrable mask of uncouth language, have been adduced as evidence and demonstration. — Dr Price's celebrated experiments may, by some, be supposed to deserve some attention; but, if it were necessary, it would be easy to shew, that these experiments are not adequate to the proof of the conclusion, which they may be thought to establish: it is said, if it were necessary, because the author himself, in his second edition, has clearly renounced all pretensions to the discovery of a mode of transmuting metals, expressing himself sorry, that “his account, to which he gave only the unassuming title of *Experiments on Mercury, &c.* should have been held out to the world, as announcing the *Discovery of the Philosopher's Stone*: this, in the usual sense of the word, he, as well as others, thinks merely chimerical.” In this edition he has studiously omitted or altered every expression or sentence, which might be thought to betray an attachment to, or a belief in, the common opinions of Alchemy. In a future more extensive appendix, the author has promised to explain his sentiments more fully on these subjects: 'till then the candid and liberal should perhaps suspend their judgment of his late publications, especially as he intimates an intention to illustrate “the principles of some of his processes, and to shew their analogy to experiments related by Chemists of reputation.” If in this line Dr Price speaks explicitly and ingenuously, much instruction

Not contented with the little success they had hitherto had in their favourite search

instruction may be expected from his chemical erudition and practical experience. In this work we may hope to see the doctrine of the original and progressive state of the bases or earths of metals clearly investigated; and the balance held with an impartial hand between the two opinions, which have been maintained on the point.

With regard to the origin and generation of metals, and the real nature of the earths that constitute their bases, naturalists have held very different opinions. It is not within the compass of my ability to discuss the question fully, and in this place it would be improper. I shall only therefore venture to introduce a few remarks in some degree connected with that division of the subject, which is more immediately before us. It has been often alledged, or implied by chemical writers^a, that there is really but one and the same basis or earth of all metals, which combined in different modes or various proportions with some other principles, particularly the Phlogiston (and sometimes the Mercurial principle is adduced) gives all the forms of metallic substances. If this theory could be confirmed, it would be very favourable to the doctrine of the transmutation, as it gives a foundation to infer, that if certain principles could be in some cases taken away, or in others superadded, the qualities, that is the nature and essence of a metal, might be changed, or in other words, it might be transmuted into another metal. That the Alchemists maintained this hypothesis is obvious from those parts of their writings which are tolerably perspicuous. That many Chemists of much later date have entertained the same sentiments is plain from the passages of *Becher* and *Stahl*, to which I formerly referred (see page 25), and particularly the second supplement to the *Physica Subterranea*, Thes. I, “De transmutationis metallicæ necessitate et
“connexione cum universo naturæ cursu.” But there is a fallacy in the defence of this Thesis, which will perhaps be found in all the writings on the same side of the ques-

^a See *Bergman's Opuscula*, Vol. I. De Arsenico; and Dr *Price's* Introduction to the 1st Edit. of his Experiments.

after gold, the Alchemists in the twelfth and thirteenth centuries advanced pretensions,

tion, which proceed upon the same mode of argument. The changes, which are there instanced in the course of nature, or the operations of art, are by no means applicable to the point in dispute: they only shew that the world and all its constituent parts are subject to alterations and revolutions; and that the animal, vegetable, and even mineral kingdom is influenced by similar laws: but they by no means prove, that in any one instance any genus or species of the natural productions, in the animal, vegetable, or mineral kingdom, has been changed into any other in that mode and degree, which the idea of transmutation implies. It holds perhaps throughout nature, that the genera and species, which compose the animate and inanimate world, are immutable and invariable; that they cannot by any natural or artificial process be so far deprived of their own essential qualities, as to assume absolutely those of another species or genus. Therefore it may be conceived, that the different metals are substances, as the naturalists say, *sui generis*, of a specific unalterable nature; and though by various artificial or even natural means, by combination, solution, precipitation, their forms may be concealed and apparently altered, yet they continue perfectly distinct however disguised. And possibly, it may be with truth alledged, that no mode of treatment, no addition, no process of reduction can really give to a metal or metallic earth any other simple homogeneous metallic form, than that which is peculiarly appropriated to it.

If this doctrine be admissible, and perhaps there are many good arguments to urge in its confirmation, the opinion of a transmutation of metals, either by art or nature, can have no foundation.

In *Shaw's Principles of Philosophical Chemistry* (Supplem. Sect. 2.) is a treatise on the Philosopher's Stone, in which he enumerates the several modes adopted by different Alchemists in this vain and fruitless search, with many curious and instructive observations, verging indeed a little sometimes to credulity.

infinitely

infinitely more absurd, to the discovery of an *universal medicine*. “The metaphorical and
“hieroglyphic manner of writing, which
“obtained amongst them, seems to have
“given rise to a practice of calling the
“means made use of for bringing metals to
“perfection by the name of medicines, the
“imperfect metals by the appellation of sick
“men, and gold by that of a healthy man
“enjoying all his faculties. Hence the uni-
“nitiated fell into the error of supposing
“that these expressions were to be under-
“stood in the literal sense, especially as the
“adepts called the impurities of the baser
“metals by the title of leprosy, which was
“then deemed the most incurable of all
“diseases.” *

These circumstances, in a superstitious and credulous age, gave rise to an opinion, which soon spread far and wide, that the persons thus endued with knowledge of the intimate operations of nature and art, were possessed of two important secrets: and it was conceived that a process, nearly allied to that which converted the baser metals into gold, gave also a preparation, an *elixir vitæ*, capable of restoring the most active health to

* Boerhaave's Hist. of Chemistry, Shaw's Edit. Vol. I., p. 26.

the most infirm body, and of perpetuating human life to an unlimited duration. The Alchemists applied this favourable opinion concerning them to their advantage, and very readily claimed a power, which the vulgar were already disposed to believe they possessed. The doctrine of the universal medicine was, I believe, first openly advanced by *Raymond Lully* about the beginning of the fourteenth century, in a tract entitled, *De Secretis Naturæ sive de Quinta Essentia*.

This prejudice in favour of the pretensions of the Alchemists naturally led them, that they might be able to vindicate their claim, to a minute examination of animal, vegetable, and mineral substances. Thus they obtained many important preparations, and by the successful application of them in a great variety of diseases, which baffled all the skill of the regular practitioners, (the implicit followers of Galen and his Arabian commentators) they still farther enforced and established the belief of their possession of a Panacea.

Not long after * *Lully*, *Basil Valentine* carried these pretensions to a much higher

* Though the precise date of the birth of *Lully* is not agreed on by authors, the year 1315 is generally allowed to have been the æra of his death. The birth of *B. Valentine*

pitch in a work, which in its title, *Currus Triumphalis Antimonii*, shews the insolence, with which he and his followers trampled upon the ruins of the system of Galen.

But the compleat superiority of the chemical sect was reserved for the age, the abilities, and the arrogance of *Paracelsus*.

This extraordinary person was born at *Einsiedlin*, an obscure town in *Switzerland*, in the year 1493, nearly at the very period when the venereal disease made its first appearance in Europe. * Its ravages spread thro' every

lentine is still more uncertain: it has been asserted that he was born towards the latter end of the 14th century, and this opinion I am inclined to adopt: but that I may not be thought to speak too confidently on this point, I will qualify the assertion by referring to Dr *Alston's Materia Medica*, Vol. I. p. 294. where the curious reader will find much information concerning the history of Basil Valentine, (if after all it be allowed that this is actually the name of a real person) and likewise concerning the use of Antimony in medicine.

* According to the most accurate historians^a, this Malady was imported from America in the very year of the birth of this extraordinary person; a remarkable concurrence of events! which can hardly pass unnoticed by any one, who is curious in investigating the connexion of causes and their effects in the moral or natural history of the world: for at the very same period, when this new plague was introduced into Europe, a man was also born, whose daring empiricism first evinced satisfactorily the powers of that specific medicine, by which alone it can be with security and certainty combated and counteracted.

^a *Robertson's Hist. of America*, Vol. II. Note 22. p. 482.

Astruc àc Moib. Ven. L. I. c. 10.

kingdom with such uncontrouled violence, as almost to justify the expressions of a contemporary poet, who painted from the life, and gives this dreadful scourge, which he denominates *Pestis*, a very distinguished pre-

It cannot indeed be asserted, that Paracelsus was the first person, who employed Mercury in the treatment of this disorder : ^a yet the consequence and influence, which the chemical sect and their doctrines acquired from his patronage and support, brought the chemical remedies more into repute ; their virtues were more extensively tried, and more generally acknowledged ; and Mercurial medicines in particular, which from the injudicious, ill-directed, or timid practice of their first employers, ^b were reprobated as ineffectual or dangerous, were found to be perfectly secure, and of the most indisputable efficacy. Therefore, though Paracelsus did not first suggest the application of Mercury in this disorder, yet perhaps we are indebted to him and his disciples for the convincing proofs of its safety and success, of which we are now possessed ; for they held up the light to succeeding inquirers, and pointed out the path, which with so much advantage to mankind, they have pursued.

That the effects, here ascribed to the prosecution of the study of Chemistry, the introduction of chemical remedies, and the consequent advantages resulting to the science and practice of medicine, are not unjustly referred to the influence of Paracelsus, and the zeal for chemical improvement, which he disseminated, is obvious from hence ; that those authors, who professedly write the history of medicine, in dividing it for greater perspicuity into distinct periods, date the seventh (that wherein the chemical doctrines prevailed in the schools) from the birth of Paracelsus, thereby acknowledging, that this revolution in medicine was principally, if not solely, to be imputed to him. ^c

^a Astruc's Catalogue of Authors. Lib. V. of his work.

^b Astruc de Morb. Ven. L. II. C. 7. p. 121.

^c Lettsom's Introduction to the History of Medicine, p. v.

eminence

eminence in his enumeration of the calamities, under which his oppressed and afflicted country groaned :

“ Quippe Lue hac nascente, (says *Fracaſtorius*)
putem ſimul omnia diras

“ Eumenidas ceciniffe fera et crudelia nobis :

“ Tartareos etiam barathro (dira omina !) ab imo

“ Exciviſſe lacus ; Stygiâque a fede Laborem,

“ *Peſtemque*, horribilemque Famem, Bellumque,
Necemque.

“ Dii Patrii ! quorum Auſonia eſt ſub numine !
Tuque,

“ Tu Latii Saturne Pater, quid gens tua tantum

“ Eſt merita ! an quicquam ſupereſt dirique graviſ-
que,

“ Quod ſit inexhauſtum nobis ? ecquod genus uſ-
quam

“ Averſum uſque adeo cœlum tulit ? * * *

He concludes this pathetic deſcription with an affectionate addreſs to his native province, the territory of Verona.

“ O Patria, ô longum felix, longumque quieta

“ Ante alias Patria, ô Divûm ſanctiſſima Tellus,

“ Dives opum, fœcunda viris, lætiſſima campis

“ Uberibus, rapidoque Atheſi, et Benacide lympha,

“ Ærumnas memorare tuas, ſummamque malorum

“ Quis queat ? et dictis noſtros æquare labores,

“ Et turpes ignominias, et barbara jūſſa ?

“ Abde caput, Benace; tuo et te conde sub amne,
 “ Victrices nec jam Deus interlabere lauros.” *

Physicians in vain ransacked the works of Galen and his Arabian commentators. They found no certain or satisfactory traces of any similar disease, and their experience furnished them with no remedy that could counteract its malignity: but that divine gift, which they so fruitlessly sought in the learned volumes of antiquity, the Chemists discovered in Mercury, the favourite subject of so many of their operations. Armed with these uncommon powers, with Paracelsus at their head, they triumphed universally in the fallen fame of their opponents. And

* *Fracaſtorii Siphylis*, Lib. I.

The following paſſage of another contemporary author, who wrote a tract expreſſly de Morbo Gallico, confirms in very ſtrong terms the deſcription of Fracaſtorius. “ Vi-
 “ demus Summum Creatorem hoc tempore, nobis iratum
 “ ob nefanda ſcelera noſtra, nos vexare cum Morbo hoc
 “ *truculentiffimo*, qui jam non per Italiam, ſed etiam per
 “ omnem pene Chriſtianam Religionem, viget. Ubique
 “ tubarum clangor ſonat, armorum ubique ſtrepitus
 “ auditur, ubique Bombardæ instrumenta bellorum confi-
 “ ciuntur, et loco ſaxorum ſphæricorum ferrea remanent,
 “ et hoc tempore inaudita fabricant; Turcæ in Italiam
 “ vocantur. Quot jam incendia, quot deprædationes, quot
 “ miſerorum mortalium ſtrages jam vidimus, quot et
 “ quantas viſuri ſumus? Utinam mentiar!

Coradini Gilini Opuſc. de Morb. Gall. citat. in *Aſtruc*
 de Morb. Ven. L. V. p. 428.

if

if this discovery alone had distinguished the labours of this sect, it must be acknowledged, that these labours would be most justly entitled to the applause and gratitude of succeeding ages.

The character of Paracelsus is perhaps the most singular recorded in philosophic history. He was a compound of great abilities and industry, combined with a heated imagination, unlimited credulity, the most consummate arrogance, and the most shameless profligacy of manners. He travelled thro' most parts of Europe, (but not in Asia, as he himself insinuates, and some of his biographers assert) collecting from every source, from physicians, barbers, old-women, conjurers, and alchemists, whatever information they could give. He despised, as empirics and adventurers in the region of literature generally do, the regular path of education. He expressed publicly his contempt of the knowledge and learning of the schools, and particularly of the Arabians: and being invited by the magistrates of Basil to deliver lectures in physic and surgery, he seated himself in his professorial chair, and ordered the works of Galen and Avicenna to be burnt with great solemnity before him. Tho' thus raised to the highest eminence in his profes-

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sion,

sion, he debased his character by the most scandalous excesses, and brought his life to a very early period, in his 47th year; though he had inculcated the opinion, that he possessed the universal medicine, with such confidence, that he seems at last to have believed it himself: for he assured his disciples, that by his *elixir proprietatis* he could extend his own life, or that of any other person, to any desired degree of duration; and even secure to them, or himself, immortality upon earth. * Paracelsus added to the

* That this account of this singular character may not be thought exaggerated, let it be compared with the following passage. In the original, references are made to those parts of the writings of Paracelsus, or other authors, from which the several particulars relative to his life are deduced. (See *Astruc*. p. 458.)

“ Paracelsus ab ætate primâ studio Chemiæ, quæ tunc
 “ in obscuro latebat, sedulò incubuit; primùm apud Joan-
 “ nem Trithemium Abbatem Spanheimensem, virum doc-
 “ tum; inde apud Sigismundum Fuggerum, virum nobi-
 “ lem, aliosque non paucos, quos ipse recenset non sine
 “ ostentatione: et arcana, quotquot reperire potuit, corra-
 “ sit undique delectu multo a *Medicis, Chirurgis, Tonforibus,*
 “ *Aniculis, Magis, Chimistis, Nobilibus et Ignobilibus*; imo
 “ etiam a *Zigeunis* (les Bohémiens, Gyplies) *Nigromanticis,*
 “ *Agyrtis, et senioribus Rusticis.*

“ Vitam duxit inopem, vagam, errabundam, multùm
 “ peregrinatus per Helvetiam, Aſſatiam, Carinthiam, Au-
 “ ſtriam, Moraviam, Sueviam, cæterasque Germaniæ pro-
 “ vincias pleraſque, sed tamen non per Galliam, Italiam.
 “ Hispaniam, Portugalliam, Angliam, Borussia, Lithua-
 “ niam, Poloniam, Pannoniam, Valachiam, Transylvaniam,
 “ Croatia, Illyricum, &c. ut ipse gloriatur in *Præfatione*
 “ *Chirurgiæ magnæ*; ac multò minùs per Arabiam integro
 Decennis,

absurd pretensions of his predecessors one infinitely exceeding them all. In his treatise entitled *de archidoxis*, we have the first traces of the doctrine of an *Alkabeſt* or *universal solvent*. This opinion has been still farther advanced and inculcated by *Van Helmont*, who revived, or rather extended it to the utmost degree, so that no addition could be afterwards made to his doctrines, * in that

“decennio, ut fingit Bickerus de *Hermete redivivo* : quâ
“de re consule Sennertum, De *Consensu Galenicorum et*
“*Peripateticorum cum Chemicis*, Cap. 4. &c. * * *

“Certe Prodigium hominis tuit, qui ebrietati et crapulæ deditus, aurigæ similis et aurigarum sodalities
“mirificè delectatus, literarum ignarus, latinè vix sciens,
“Magiæ credens, volens ipse Magus credi, nomen Professoris S. S. Theologiæ tibi falso assumens, circa Religionem delirans, mente parùm consistens, nugivendulus, fabularum artifex egregius, opinionum portenta
“vocibus novis, inauditis, barbaris, monstruosis occultabat.

“Omnia enim stolidi magis admirantur amantque,

“Inversis quæ sub verbis latitantia cernunt.”

Lucret. L. 4.

It is needless to add more. If further information is required on this head, the reader may be perfectly satisfied by consulting *Boerhaave* and his commentator, and the extracts which they have made from *Le Clerc*, *Bacon*, &c. I shall only subjoin one observation from Dr *Shaw*, as it will add force to what I have asserted above concerning the effect of the doctrines of Paracelsus. “What contri-
“buted still more to his reputation was, his becoming
“acquainted with the excellency of Mercury in the Venereal Disease, which had then newly broken out, and
“spread itself over Europe.”

Shaw's Boerhaave, Vol. I. p. 40.

* *Boerhaave* informs us, that though he had examined the works of *Paracelsus* with minute accuracy and labour, he

medley of truth and nonsense, which he gave to the world as the result of 30 years expe-

he was not able to find more than one passage, in which the doctrine of an *Universal Solvent* or *Alkahest* was alluded to. From so slight a source *Van Helmont* derived his original idea; and his enthusiastic imagination readily ascribed to this wonderful menstruum an extent of operation and influence, which only such a mind could conceive; an influence, so important and universal, that *Boerhaave* and *Boyle* both acknowledged, if it was ever revealed to mortals, it was the most precious of all the gifts which divine goodness had bestowed, infinitely more valuable and more to be desired, than the Philosopher's Stone. Dr *Shaw* in one of his notes seems to allude to a distinct tract of *Van Helmont* on this subject, but I believe none such was ever published. *Boerhaave* in his account of the *Alkahest* constantly refers to *Helmont's* general works, where the traces of this doctrine are scattered every where without any order or method.

The learned reader will find many references to these passages in most of the systematical writers who succeeded *Helmont*, particularly in the *Physica Subterranea* of *Becher*, in the supplement to that work by *Stahl*, and in the numerous treatises of *Boyle*; but it is needless to search after detached paragraphs in these voluminous writings, when the whole doctrine is so fully displayed and illustrated by *Boerhaave*.^a It may not be useless to observe, that the references, both in the original and in the translation, have relation to the Amsterdam *Elzevir* edition published in 1652, which, Dr *Shaw* expressly says, is the most accurate, and the most complete, collection of *Helmont's* works. The concluding sentence of *Boerhaave's* account of the *Alkahest* may perhaps be thought to shew, that even his great mind (and the same may in some degree be alledged of *Boyle*,^b but more certainly of *Becher*^c) received so strong an impression from the positive assertions of *V. Helmont*; that, like another

^a *Boerhaavii Chemia Edit. Lugd. Batav. Vol. I. p. 848. Shaw's translation, Vol. I. p. 569.*

^b *Boyle's works, 4to. Vol. I. p. 435, 560, 636, 653, 654. Vol. IV. p. 298.*

^c *Becheri Phys. Subterranea. L. I. Sect. III. C. IV. N. 9, et seqq.*

distin-

rience in a profession ; to which, he informs us, he was expressly commanded to dedicate his life by the Divine authority, delivered to him by the angel Raphael in a dream. But tho' his vanity persuaded him to commit his crude conceptions to writing, he appears, at the conclusion of the account of his studies, to have been sensible, that he had been deluded by a phantom : “ Tandem cum Salomone cognovi, me frustra adhuc spiritum meum torfisse, vanamque esse scientiam omnium, quæ sub sole sunt, vanas curiositatum indagationes. Et quem Dominus Jesus vocaverit ad sapientiam, ille et non alius venturus est : imo qui ad fastigium

distinguished writer of the present age, on a subject equally futile with that which we are now discussing, “ though he never could advance his curiosity to conviction,” he seems at the conclusion of his account to have been, even in opposition to his own judgment, “ *willing to believe.*” For he says, (I use his own words, that his opinion may not be supposed misrepresented by a translation) “ Ultimo jam tandem quæretis a me, ut aperiã an crediderim unquam ulli Chemicorum possessum fuisse tale arcanum ? Libere responderim, Helmontium conqueri, lagenam semel datam, iterum ablatam ipsi fuisse ; unde certum, non potuisse eum tot experimenta illo liquore facere. Paracelsus vero tot et talia non scribit de suis solventibus. Quare vere nescio, quid de ipsa re dicam. Id pro vero dixerim, consuluerimque, Salem Marinum et Mercurium omni modo chemico tractare, nunquam poterit operæ.”

Boerhaavii Chemia, Lugd. Bat. Vol. I. p. 868.

“ perve-

“pervenerit minimum adhuc poterit, nisi
 “Domini favor benignus affulserit. En sic
 “adolevi, factus vir, nunc quoque senex
 “inutilis, et ingratus Deo, cui omnis ho-
 “nor.” * We may dismiss this subject by
 observing, that the absurdity of searching for
 an universal solvent is well shewn by that
 question of *Kunckel*, “If it dissolves all sub-
 “stances, in what vessel can it be con-
 “tained?” †

At the same time it is but justice to the
 memory of *Helmont* to acknowledge, that
 in his writings we find the first traces of

* *Van Helmont*, Oper. Studia Authoris, §. 19.

The whole of this chapter is a lively picture of the in-
 fluence and operation of vanity combined with fanaticism
 on the human mind; and may therefore be considered by a
 contemplative reader not merely as the effusion of a mad-
 man, but as conveying useful instruction, and presenting
 a striking memento, how wild and erroneous are the flights
 of unrestrained imagination, and how absurd the arrogance
 of intellectual pride.

Of all the passages in the writings of the numerous fa-
 natical authors, which may be thought to bear any resem-
 blance to this prayer and dream of *Van Helmont*, there is
 perhaps none more nearly parallel to it, than the celebrated
 description given by Lord *Herbert* of *Cherbury* of the sign
 he received from Heaven, in answer to his earnest prayer
 to be certified by some particular revelation, that the pub-
 lication of his treatise *De Veritate* would tend to promote
 the interests of religion and the advantage of mankind.

See *Leland's* view of the Deistical writers, Vol. I. p. 469.
Biogr. Britan. Vol. 7. p. 88.

† *Neumann's* Chemical Works, by *Lewis*. 8vo. Vol. I.
 p. 153.

many

many important doctrines in physiology, pathology and Chemistry, which are now generally received. In Chemistry particularly he was the first person who had any idea, or at least who has left any account, of the various permanently elastic fluids or gases, extricated in different operations. But his knowledge of these fluids seems not to have had any sure foundation in experiment, or any other support, than the casual observation of an ingenious man, more intent on framing theories than establishing new facts. His observations and doctrines were quickly exploded together, and remained for ages buried in the confusion and obscurity of his works. It is even probable, though it must appear extraordinary, that his writings never suggested the idea of any of these fluids to the philosophers, who in a later period have again revealed their existence and proved it by experiments. But while on these accounts we pay due honor to our modern experimentalists, we ought not to refuse the applause, which is most justly due to the sagacity of Helmont. *

CHEMISTRY, being thus intimately connected with the healing art; and en-

* *Keir on Gases. Preface. P. XI. XII.*

Cavallo on air, &c. Part II. Ch. 4. p. 248, et seq.

riched with innumerable discoveries in metallurgy and mineralogy, in the preparation of colours, enamel, and glass, and in the processes of distillation and fermentation, made rapid advances towards perfection. The great success of Paracelsus and his disciples in the cure of diseases convinced the physicians of the next age, that the solemn Anathemas, which had been pronounced by many celebrated universities against the chemical doctrines and remedies, enforced in some instances by the powers of law and even regal authority, * were solely the dic-

* By the university of *Paris* against *Quercetan* and *Mayerne*. See *Apolog. pro Hippocrat. &c. adversus Quercetan.* p.91. and *Ad famos. Turquet. Apologet. Responso.* p.97.

By the same university against *Ramus* and others; see *Launoy, de variâ Aristot. in Acad. Paris. fortun. c. 13. 17.*

Narrative prefixed to *Pemberton's* dispensatory. P.35.

The following extract, which exhibits the dates of what may be called the revolutions of antimony, the periods when it was considered as a valuable medicine, and those when it was regarded as a poison, shews at the same time, how long some remains of the ancient prejudice against the chemical remedies survived, and how often they were by some trivial cause called into action. "Never did any remedy meet with so inconstant a fortune, with regard to phylic, as antimony has done. Scarcely towards the 12th century, came it out of the darkness of the mines, by the assistance of Valentine the monk, when the ill success of the experiments made by that artist on the unhappy monks his brethren (if the story be not fabulous) made it return thither a long time. Three hundred years after, Paracelsus drew it out a second time, and antimony began to establish itself; when in 1566 it was
"thunder-

tates of ignorance, pedantry, and prejudice. With minds uninfluenced by preconceived opinions, they could review the practice of the disciples of Valentine, Paracelsus, and Helmont without envy. They saw and acknowledged the extensive efficacy of the chemical remedies, and endeavoured to discover their preparation in the patient path of experiment, whereby those remedies and their virtues had been first detected. And as they employed their discoveries to the advantage of their contemporaries, so they delivered them down in their writings with equal candour and perspicuity to succeeding ages. These authors were so numerous, that it would lead me to a greater length, than can be afforded in this place and at this time, to enumerate their particular merits.

Many circumstances contributed about this period to dispel that darkness, which

“thunderstruck by an arret of parliament, and one Bessier, a physician, in 1609 transgressing it, was excluded the faculty. In 1637, by public authority, it was again received into the number of purgatives. In 1650 a new arret rescinded that of 1566, and brought antimony into reputation. And, on the 29th of March 1668, it had again the sanction of public authority, by which graduates had a liberty of making use of it, but with a prohibition to all others, except with their advice.”

Savary's Dictionary. I. 109.

Pomet's Hist. of Drugs. B. III. Vol. 2. p. 357.

Alston's Mat. Med. Vol. I. p. 295.

had so long overwhelmed the world of letters : and Chemistry, equally with the other sciences, felt the beneficial effects of those causes, which conspired to the revival, and encouragement of every branch of learning. By a free intercourse with that part of Asia, which had formerly been possessed by the colonies of Greece ; and more particularly in consequence of the taking of Constantinople,* (when many persons, who alone retained any knowledge of the Greek language, or possessed any copies of their original works, took refuge in Europe from the dreaded tyranny of the Turks,) the treasures of Græcian eloquence and erudition had been gradually laid open. † From these

* In 1453.

† *Hume's Hist. of England. Vol. III. Ch. 26. ad finem.*
Aikin's Biograph. Memoirs. p. 21.

Before this period the language of ancient Greece was almost obliterated in Europe, and the Arabian translations were the only means by which any knowledge of Greek literature was preserved. It is far from my intention to defraud the Arabian translators of any share of their reputation, as the *præcursors* of the revival of learning. I perfectly accede to the opinion of Mr Warton,^a and most other writers on these subjects : but the following observation of a very eminent historian, concerning the learning of the Arabians, and the degree, in which they cultivated the study of the Greek authors, seems to be perfectly just and well-founded.

“ When the Arabians,” says Dr *Robertson*, “ turned
 “ their attention to the literature cultivated by the ancient

^a See the reference to Mr *Warton's* dissertations, p. 38. of this tract.

“ Greeks

refined sources, men had by similar gradations acquired a more liberal and enlarged mode of thinking. “ They recovered the
 “ powers of enquiry and reflection, faculties
 “ of which they seemed long to have lost
 “ the use.” ‡ And by the art of Printing, which was discovered nearly at the same time, the facility both of acquiring and propagating the refined sentiments, the ele-

“ Greeks and Romans, the chaste and correct taste of
 “ their works of genius appeared frigid and unanimated to
 “ to a people of a more warm imagination. It was im-
 “ possible for them to admire the poets and historians of
 “ Athens and Rome. But they were sensible of the merit
 “ of their philosophers. The operations of the intellect
 “ are more fixed and uniform, than those of fancy and taste.
 “ Truth makes an impression nearly the same in every
 “ place; the ideas of what is beautiful, elegant, or sub-
 “ lime, vary in different climates.” It may be therefore urged, without any suspicion of prejudice, that tho’ the Arabian writers, previously to the taking of Constantinople, had preserved in Europe a slight knowledge of the Grecian logic, medicine, and philosophy; even this knowledge, disguised by minute subtleties and metaphysical disquisitions, was also deprived of the graces of the original language, in which it had been conveyed. From hence it naturally happened, that their translations were but little read, and produced no general effect. At the same time the divine works of the historians and poets of Greece were totally neglected, and seemed buried in oblivion; ’till this great event brought them again to light. Then the Genius of ancient Greece appeared in his native, simple, and most attractive attire, with an influence very similar, and not inferior, to that ascribed by Tully to the appearance of Virtue in a visible form, “quæ si oculis cerneretur, mirabiles amores, ut ait Plato, excitaret sapientiæ.” *Cicero de Off. L. I. C. 5.*

‡ *Robertson’s Hist. of Charles V. Vol. p. 169.*

gance,

gance, taste, and philosophy of Greece, was wonderfully increased. * The revival of learning by degrees introduced the Reformation of Religion ; † and this Reformation still farther encouraged those enlarged views, which the study of the ancient authors had inspired. “ The human mind was now
 “ roused, by irresistible causes from the le-
 “ thargy, in which it had been sunk for so
 “ many ages.” The same ardent spirit of inquiry displayed itself in the exertions of the professors of every science ; and the Chemists found a new and extensive field for the employment of their industry and zeal in the treasures of America and the East, which had been lately revealed to the old world, by the successful voyages of Columbus and Gama. ‡

* See *Robertson's Hist.* ubi sup. p. 168, & 169.

† Luther openly declared his opposition to the Pope in 1520.

‡ *Columbus* discovered the New World on the 12th of October 1492, and arrived, after his first voyage, at Lisbon, Feb. 24. 1493.

Gama sailed from Lisbon on the 9th of July 1497, doubled the Cape of Good Hope on the 20th of November following, on the 22nd of May 1499, he arrived at Calicut on the coast of Malabar, and landed on his return at Lisbon, on the 14th of September 1499.

See *Robertson's Hist. of America*, 8vo. Vol. I. p. 130, et seq. and p. 208, et seq.

These are to be marked as the periods, when the treasures of America were revealed, and those of the East rendered

From this æra the number of Chemists, and chemical writers increased immensely; so that it would be almost impossible even to enumerate their names. But still their works were not entirely free from the mysterious jargon of Alchemy. Their theories were obscured and clouded; and these illusions would perhaps have continued to this day, had not our illustrious Countryman, BACON, pointed out the true path of chemical and physical inquiry, by discountenancing the absurd hypotheses which prevailed, and directing men to the true source of the knowledge of nature, Experiment. “It has ever been the misfortune of philosophical Genius,” says an elegant writer, * “to grasp at objects which Providence has placed beyond its reach, and to ascend to general principles, and to build systems, without that previous large collection of facts, which alone can give them a solid foundation.” * * * * * “Genius is naturally impatient of restraint, keen and impetuous in its pursuits; it delights there-

dered more accessible to the European nations, tho’ many years elapsed before the true value of these discoveries was known, or the productions of these distant countries properly examined, and applied to the purposes of the arts and medicine.

* Gregory’s comparative view. Vol. I. p. 114. ed. 6th.
“fore

“ fore in building with materials, which the
 “ mind contains within itself, or such as the
 “ imagination can create at pleasure. But
 “ the materials, requisite for the improve-
 “ ment of any useful art or science, must all
 “ be collected from without, by such slow
 “ and patient observation, as little suits the
 “ vivacity of genius, and generally requires
 “ more bodily activity, than is usually found
 “ among philosophers.” * But BACON re-
 called philosophy from the altitude, to which
 she was continually soaring, and fixed her
 down to her proper station. He confined
 her labours to the patient path of experi-
 ment ; and seeing, with a prophetic eye,
 what a change this doctrine, if pursued, would
 effect in science, he did not hesitate to prefix

* The following passage in the introduction to the *Opuscula* of the celebrated professor *Bergman*, to whom modern Chemistry owes great obligations, corresponds with, and will enforce, these observations of Dr Gregory.

“ Scilicet ab una parte, perquam cara, molesta et longa
 “ est *via experimentalis*. Hanc igitur non omnium ferunt
 “ facultates : multis defunt idonea instrumenta : aliis ne-
 “ cessaria dexteritas : plerisque sufficiens patientia et con-
 “ stantia ; nam, si res statim non succedit, fastidiendo co-
 “ natum deserunt. Homo sibi relictus per naturam otio est
 “ deditus. Ab alia parte *via contemplativa* nostræ sciendi
 “ cupiditati favens, et cito et faciliè sacraria naturæ rese-
 “ rando, demulcet inexplabile omnia explicandi deside-
 “ rium ; vanam arrogantiam focillat, omnia nostro intel-
 “ lectui pervia fingendo.”

Bergman Opusc. Vol. I. Introd. p. iv. De indagando
 vero.

to this important system the title of *Instauratio Magna* : having at length, as he himself expresses it in his dedication to the King, pointed out the way, by which “ post tot
 “ mundi ætates, philosophia and scientiæ non
 “ sint amplius penfiles et aereæ, sed solidis
 “ experientiæ omnigenæ, ejusdemque bene
 “ pensitatæ, nitantur fundamentis.”

The evident truth of this doctrine had an immediate influence on the study of natural philosophy and Chemistry. Societies of studious and ingenious men were formed, with the professed intention of collecting facts and promoting experimental knowledge. Of these none were more early established, none have obtained a higher reputation, than those of *Paris* and *London*. * Amongst the eminent chemical authors, who distinguished themselves soon after this reformation of the science of nature, the names of *Newton* and *Boyle* deserve particular notice. The active and comprehensive mind of Newton,

Dr *Sprat* says, “ the Royal Society had its beginning in
 “ the wonderful pacific year 1660, so that if any conjec-
 “ tures of good fortune, from extraordinary *nativities*,
 “ hold true, we may presage all happiness to this under-
 “ taking.” *Hist. of the Royal Society*, p. 58. But I believe
 the date of their charter of incorporation is on the 15th
 of July 1662.

The Royal Academy of Sciences at Paris was instituted
 in 1666.

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found

found not sufficient employment in the sublimer sciences of geometry and astronomy, but investigated with equal ardour the most secret recesses of nature by physical and chemical experiments. But in the annals of Chemistry no name deserves a higher eulogium than that of Mr. Boyle. Of a mild and amiable disposition, and a delicate frame of body, he was not formed to take an active part in those unhappy tumults, which distracted this country during the earlier part of his life. Thus the circumstances of the times concurred with his own philosophic temper to induce him to devote his life to literary pursuits, to an investigation of the properties of bodies, the powers and operations of nature, the inventions of art, and all the various branches of speculative and practical Chemistry. He was the author of almost innumerable tracts, composed with equal candour and spirit. His style may perhaps be deemed by some incorrect or too diffuse; but that was less his own imperfection than that of the age in which he lived, when a florid and luxurious mode of writing was considered as the most elegant and expressive. * He held an open and candid

* See the very just observations of the ingenious Dr *Warton* on the style of the writers of *Charles the Second's* reign. *Essay on Pope*. Vol. I. p. 157.

communication with all the eminent Chemists of his age, and while he resided in this place during the civil wars, he invited the lovers of the science of nature to frequent meetings and literary conversations ; and thus formed the rudiments of that celebrated Society, which after the Restoration obtained the Royal approbation and patronage, and has since held so high a rank, and an estimation so well deserved, amongst the literary societies of Europe. † But the attention of the learned in England to Chemistry was considerably interrupted by *Harvey's* * discovery

† As this University has had the honour in some degree of laying the foundation of a Society so justly celebrated, it cannot but be regretted that meetings of this kind are so little encouraged here. The utility of them cannot be denied : the general disposition of the learned and ingenious in every considerable town in this island, and on the continent, to form such societies evidently shews the pleasure and advantage, which results from them. But we need not look into the world for proofs. Our own situation furnishes one equal to a demonstration, as the seeds of the Royal Society were planted, and grew, and by such careful and tender treatment were fostered and cherished in this very soil.

* *Harvey* published his doctrine of the circulation of the blood in 1628 : and therefore it may be thought extraordinary, that this celebrated event in the annals of medicine should be mentioned amongst the causes which retarded or impeded the study of Chemistry in England forty or fifty years after : but it should be observed, that it is only mentioned as a co-operating cause, acting in conjunction with other circumstances, which particularly encouraged mathematical studies in this kingdom, and gave

of the circulation of the blood, and by the doctrines and controversies to which it gave

to geometry so great a pre-eminence over all other sciences. Soon after Harvey's first publication of his work the civil wars, or at least the unhappy controversies which led to them, broke out: and therefore this extraordinary discovery did not for many years shew its proper influence on the studies and pursuits of those, who cultivated any branch of natural philosophy in this country. It was not till learning began to emerge from the obscurity, which had overwhelmed it during the tumult and distraction of the nation, that this influence was experienced. The doctrine of Harvey had been in the mean time violently attacked and opposed on the continent, and even in this island. The defence, or confutation of it, required a knowledge of the general laws of Hydrostatics and Hydraulics, and of the forces, by which fluids contained in certain canals, may be propelled in a continual or alternating stream, as well as of the resistances, which may accelerate or retard, interrupt or obstruct, their free course. But an acquaintance with these laws is intimately connected with the fundamental principles of mechanical philosophy, of which Geometry is the basis: it is therefore no unreasonable assertion, that these disputes tended in a considerable degree to the encouragement of geometrical studies in preference to all others. It is however certain, that the mathematical doctrines, still farther encouraged by the astonishing researches of Sir Isaac Newton and some others, prevailed so universally, not only in England, but on the continent also, that the system of medicine was entirely occupied by them, and the chemical theories almost totally excluded. This change establishes an 8th æra in the history of physic, the æra of the mechanical dogmatism, a period concerning which it is to our purpose to observe, that its distinguishing character is the prevalence of the mathematical doctrines, that its introduction is marked by Harvey's discovery of the circulation of the blood, and the exclusion of Chemistry, and that its conclusion is distinguished by Boerhaave's incorporation of the mechanical and chemical systems into one,

rise,

rise; but still more by the wonderful progress of Sir *Isaac Newton* in the investigation of the laws of the planetary system. Hence the studies of astronomy and geometry were introduced most justly into general repute in England: but unhappily, while these sciences were cultivated with the greatest advantage and success, many others were excluded and neglected, as unnecessary to the perfection of a liberal education. Medicine in a very particular manner felt the influence of this system. The doctrines of Chemistry were rejected. Not only the theory, but even the practice of physic, was conducted and explained upon mechanical or geometrical principles. Chemistry of course was disregarded and uncultivated, except by a few retired persons for their amusement. But in Germany it had a different fate. Besides authors of inferior note, *Stahl*, *Hoffmann*, and *Boerhaave*, three of the most illustrious names recorded in the annals of philosophy, not only sustained, but advanced the reputation of Chemistry to a height, which it required the most consummate genius to attain. The genius indeed of *Stahl** was exceeded only by his indefatigable industry.

* *Leslie* on Animal Heat, Ch. II. p. 103.

Dictionary of Chemistry, preliminary discourse. P. x.

He seems to have taken in at one view the almost boundless range of chemical phenomena, and by maturely weighing and judiciously placing them in their proper light, has formed a satisfactory theory of many of the most important operations of nature. His theory, especially that which relates to fire and the principle of inflammability (formed indeed, it must be acknowledged, on the principles of his predecessor *Becher*†), has not been invalidated by time, the sole impartial test of systems : on the contrary, it is every day more and more confirmed by the various advances, which are daily made in Chemistry and natural philosophy. *Hoffmann's* excursions in the wide field of theory were less extensive. His distinguishing character, as a chemist, seems to have been an extreme patience and perseverance in investigating by experiment the qualities of bodies. We find ourselves indebted to his labours in almost every branch of the science, but principally in the examination of mineral waters.† More modern observations have carried this investigation to a greater degree of perfection ; but almost the first rudiments, from

* *Id. ibid.*

† *Boerhaave's Chemistry*, by Shaw. Vol. I. p. 60. Note x.

which

which all the subsequent improvements have sprung, we owe to the industry of Hoffmann. While Stahl and Hoffmann thus revealed the arcana of particular divisions of the great kingdoms of nature, *Boerhaave*, taking a more comprehensive view of the science of Chemistry in its utmost extent, diffused a new light over every part. He collected the observations of all former chemists; he examined their theories; he repeated their experiments; he compared them with those of his contemporaries; and having collected an immense treasure of chemical facts, he formed the whole by his uncommonly methodical genius into a most perfect system, that has long been, and must ever continue, the object of universal admiration; a system so perfect, that most writers, who have given the history of Chemistry, have concluded their narration with this great name, as if no addition had been since made, or could be afterwards expected, in the Science. *

But Chemistry, being founded in experiment, can have no limitation. We may most justly use of this science the words, which a celebrated ancient writer employed, when speaking of the acquisitions of learning

* *Dictionary of Chemistry*, English, prelim. Disc. p. xi.

in his time : “Patet omnibus veritas; nondum
 “ est occupata : multumque ex illâ etiam fu-
 “ turis relictum est. Multum adhuc restat
 “ operis multumque restabit : nec ulli nato
 “ post mille sæcula precludetur occasio ali-
 “ quid semper adjiciendi.” * At the very
 time, when it was supposed, that Boerhaave
 had completed the chemical system, and had
 left nothing to posterity to add to his work
 but further illustrations by the collection of
 new facts, Dr *Hales* connected the chemical
 and mechanical principles in his explanation of
 the phænomena of vegetation, and by a series
 of most interesting and engaging experi-
 ments, laid open a perfectly new path, † and

* *L. Ann. Senecæ. Epist. 64.*

“ Fundamento jam posito,” says Dr *Watson*, speaking of
 the progress of Chemistry, “molem extruxere paululum
 “ recentiores, felici admodum solertia; nec ædificio ad-
 “ miniculum, nec forma deest : fastigium operi quod in-
 “ finitum est, nulla ingeniorum sagacitas, nulla temporum
 “ diuturnitas unquam imponet.”

† I have mentioned Dr *Hales* as the introducer of the
New Philosophy, tho’ I do not mean to deny that both Hel-
 mont and Boyle had before taken notice of the elastic
 fluids extricated in various processes, or to assert that Hales
 has in any degree a prior claim to the discoveries of *Brown-*
rigg, *Cavendish*, *Black*, or *Priestley*, &c. but as M. *Lavois-*
ier has observed, (*Opuscles Physiques et Chymiques*, Chap.
 III.) Dr Hales was the first person who conceived any
 idea of, or instituted any experiments to demonstrate, the
 quantities either absorbed or extricated in such cases. Dr
 Hales likewise employed much time in analysing various
 bodies, particularly the human calculus, and the prepara-
 tions recommended as Solvents or Lithontriptics; the ana-
 lysis

led the way to those curious investigations of the nature of fire and air, which distinguish the history of natural philosophy in the present age. Yet so great was the attachment of the lovers of learning in England to the study of the sublimer parts of geometry, that possibly this new path might have been long deserted and untried; had not the British parliament, (anxious to satisfy the humane desire of the nation to discover a remedy, whereby the excruciating torments attending calculous complaints might be alleviated,) proposed their premium for the publication of Mrs. *Stephens's* solvent, which in private practice, under her own directions and administration, had been for several years productive of the most salutary effects.* But this grant led the way to

lysis of which substances was greatly assistant in introducing the experiments on elastic fluids. Therefore it certainly may, without violence to truth, be alledged that his observations led the way to those later discoveries in Chemistry, which are connected with them by a chain so regularly continued. See more on this subject in the next note.

* As this celebrated medicine has been the object of so much attention and dispute, and has produced such important consequences in Chemistry and medicine, a few observations relative to its discovery and publication may not be impertinent.

Mrs *Joanna Stephens*, the daughter of a gentleman of good estate and family in Berkshire, about the year 1720, accidentally met with a receipt for the stone, consisting

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of

much altercation in the philosophical world, some strenuously maintaining that this boasted

of egg-shells dried in an oven, and powdered, which she administered to several persons. After some trials she began to burn the egg-shells; and it was found, that the powder was more efficacious in proportion as the egg-shells were more burnt. She afterwards found it advantageous to add the ashes of some burnt vegetables, a decoction of herbs, and a little alicant soap. The reasons for these additions and alterations it is not within the compass of my present intention to suggest. I am only giving an outline of the history of this discovery, as of a remarkable æra in the annals of Chemistry. This improved composition she used many years with great success. Her reputation increasing considerably, in the year 1735 the *Hon. Ed. Carteret* began her medicines, and received such signal benefit, that the attention of the public became excited and engaged. In 1737 the cures performed by her were so many, and so well attested, that the speedy publication of them was judged to be of great importance to mankind. And accordingly in 1738, a proposal for raising 5000 l. by contribution, as a reward to Mrs *Stephens* for discovering her medicines, was made to the public with her consent. (See a list of the contributors, at the end of *Hartley's* view of the evidence for and against Mrs *Stephens's* medicines.) But as this proposal did not meet with success, she was advised to apply, in the year 1739, to the House of Commons by petition for the abovementioned reward, submitting her medicines, when discovered, to such examination, as the house should think fit, before the payment of the reward. The bill passed both houses, and had the Royal assent, June 14. of the same year. She presented a paper, containing her method of preparing and giving her medicines, on the 16th to the Archbishop of Canterbury (the first named of a committee composed of the great officers of state, the censors of the college of physicians, and several other eminent physicians, surgeons, and natural philosophers). This paper was published in the *Gazette*, by order of the committee, June 19. On the 5th of March 1740, the trustees, convinced that sufficient trials had

medicine was not a solvent of the stone; others affirming that there had been given

had been made, and satisfactory proofs adduced, both of the efficacy and even of the solvent power of the medicines, signed the certificate required by the act of parliament, and on the 17th of March following she received the reward of 5000*l.* from the exchequer.

Supplement to Hartley's present state of the evidence, &c.

Mrs Stephens never asserted, that this medicine was of her own invention. It was probably borrowed from some old family-receipt book. And, not with an intention to detract from that degree of merit, which may be thought to belong to her, it may be observed, that the use of all the substances, recommended in her prescriptions, had been pointed out by numerous authors long before, though not exactly in the same form, as efficacious in diseases of the kidneys. Thus *Gerard* speaks of the diuretic, nephritic, and lithontriptic virtues of all the vegetables, which are received either into her pills or her decoction. (See *Hartley*, uti sup.) It may be said, that he does not direct them to be burnt, but this hint might be borrowed from some other author, when once the idea was adopted, that in any state of preparation they possessed such virtues. *Boerhaave* remarks (*Chemiæ*, Vol. 2. p. 53.) that *Basil Valentine* prepared a medicine for the gout and stone from the ashes of burnt vine twigs in preference to any other alkali, which plainly shews that an opinion of the efficacy of alkalies in this intention was not of modern date. And indeed *Sennertus*, in his dissertation *De Calculo*, (*Sennerti Op.* Vol. II. p. 1100) bestows very high encomia on a Liquor Nephriticus made with salt of white tartar. We are informed also by Dr *Rutty* (see *his account* of some experiments on Mrs Stephens's medicines, p. 13.) that *Hermannus* long ago remarked the virtue of quicklime in cases of the gout and the stone: and *Van Swieten* (*Comment. in Boerhavi Aph.* Vol. V. p. 314.) has added to this testimony those of *Basil Valentine*, of *Bartholinus*, and an English physician of the name of *Dickinson*. The solvent qualities of alkalis and quicklime being once admitted, the addition of soap to the composition was naturally suggested, both from its

the most indisputable proofs of its efficacy. It is not my design to enter upon the discussion of this question. I only mention it to observe, that these disputes were productive of more beneficial effects, than usually result from such causes, and tended greatly in their consequences to the revival of the study, and the enlargement of the objects, of Chemistry. Several ingenious men, who took no interest in the dispute, except as far as it was connected with medicine and Chemistry, prosecuted an analysis of the composition itself, and having discovered that its most efficacious ingredients were alkaline salt and calcined calcareous earth, they were insensibly led into a more minute examination of the nature and qualities of these substances, and the properties upon which their

established reputation as a menstruum and detergent, as also from the knowledge of its composition, in which a large quantity of alkaline salt, and perhaps sometimes a little lime, is covered and guarded with a soft bland oil.

This imperfect history of Mrs Stephens's medicine will not be thought superfluous, if it be recollected that to this medicine we owe in no small degree the experiments of *Hales* on Calculi, and the ingenious tracts, on the same or analogous subjects, of *Hartley*, *Rutty*, *Whytt*, *Alston*, and many others, which led the way to the observations of *Brownrigg*, *Black*, *Cavendish*, *Priestley*, and almost all the writers of the present day, who have enriched the collections of philosophy with their invaluable experiments on air and elastic fluids.

chemical

chemical and medicinal powers may be supposed to depend. This inquiry introduced that series of experiments, which have immortalized the names of *Brownrigg*, *Cavendish*, *Black*, *Macbride*, *Priestley*, and many other ingenious persons of our own country, to whom Chemistry owes almost infinite obligations ; and those of *Venel*, *Lavoisier*, *Scheele*, *Bergman*, *Fontana*, *Volta*, *Ingenhousz*, and many other illustrious foreigners. At the same time, that one branch of Chemistry has received so great additions and improvements, the science in general has been introduced into more universal repute and regard ; and every branch has received a proportionable share of cultivation and advantage. And the more this science has been cultivated, the more has its connexion with all those arts, which have a most material influence in human life, been discovered and acknowledged. As this union of Chemistry with the arts immediately connected with all the comforts and necessities of life, has been before insisted upon at large, I need not recapitulate, even in the abstract, what has been already advanced : yet I cannot conclude without congratulating you on the advantages, which we of this age enjoy. The science, which we wish to cultivate
and

and to recommend, is now distinguished every where by peculiar and partial favour. The taste of the age for philosophy in general; the protection of princes; the zeal of many eminent, intelligent, and independent persons, attached not by profession, but by inclination, to the science; the skill, the ardour, and the integrity of modern chemists seem to promise the greatest and the most brilliant discoveries. * You have thus seen, traced out in a regular historical plan, the origin of Chemistry from necessity; the slow and obscure increase, which it received from avarice; and the quick advances, which it made towards perfection, when it was nurtured by philosophy and patronized by power.

In this view of the history of Chemistry (though perhaps it may still appear sufficiently long) I have given only a general outline. I have touched only upon the principal points and have enlarged on these discoveries only, and their inventors, which have produced some memorable revolution in the science. It was impossible to pay due honour to the name of every illustrious chemist, who has enriched the art. Many

* *Dictionary of Chemistry*, Eng. Transf. Prelim. Disc.

names have been omitted, without any intentional disrespect, from the contracted nature of the plan ; my sole intention being to give such a view of the history and progress of this science, as might animate my audience to pay a just attention to a branch of knowledge, which has been the indirect cause of some events the most singular in history, and is every day productive of advantages the most beneficial to mankind. It has therefore a double claim to the favour of those who cultivate literary pursuits either for instruction or amusement, as it furnishes an ample field for the gratification of that principle, so inherent in our nature, the love of novelty ; and at the same time holds out the prospect of the most substantial improvements in some of the most important objects of public and private attention, in the mechanic arts, in medicine, in agriculture, and in commerce.

FIG. I.

The Sun and Gold.



FIG. II.

The Moon and Silver.



FIG. III.

Jupiter and Tin.

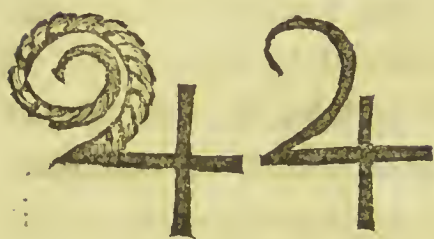


FIG. IV.

Saturn and Lead.

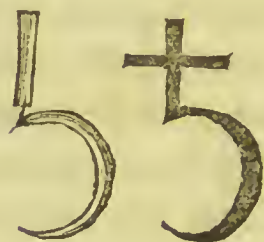


FIG. V.

Mars and Iron.

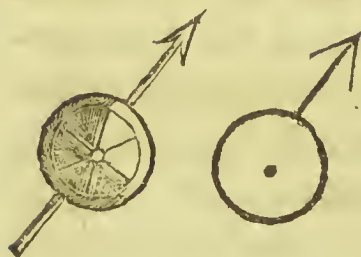


FIG. VI.

Venus and Copper.



FIG. VII.

Mercury and Quicksilver.



T R A C T II.

Conjectures concerning the Origin and
Antiquity of the Use of Symbols in
ASTRONOMY and CHEMISTRY.

THE origin of writing must be conceived to be co-eval with the first formation of society. I do not here speak of alphabetic writing (the invention of a much later period), but of that mode, in which the ideas of the mind were conveyed, and the transactions of men recorded, by actual, though rude, representations or pictures. The investigation of this subject has given employment to many able men,* and much satisfactory information may be ob-

* See particularly the Origin and Progress of the Sciences by the President Goguet, Eng. Translat. Vol. I. p. 174.

tained from the perusal of their learned researches, by which the progress of this method of writing has been traced in the early histories of almost all nations, previous to the introduction of alphabetic characters. We cannot be surprized therefore to find some traces of this first mode of writing in the records of those sciences, which have any pretensions to great antiquity; or that the use of them should be adopted in other arts, which aspire to the same reputation of primeval invention. Thus the use of symbolical characters has been admitted into the sciences of Astronomy and Chemistry. It is not my intention to enter into a disquisition concerning the origin of symbolical, or as they are frequently called from their application in religious rites and on sacred monuments, hieroglyphic characters, any farther than to shew in some degree the reason of their introduction into these two sciences, and particularly that, which is the peculiar object of my profession.

Whoever engages in chemical pursuits, and in the study of chemical authors, cannot but remark with some degree of curiosity, how extensively the use of symbols has prevailed in this science. He is naturally led to inquire from whence this practice originated; and

and whether the characters employed are merely arbitrary, or have any relation, real or imaginary, to the substances represented by them. That many of these signs are entirely arbitrary is commonly supposed by those, whose acquaintance with such writers is slight and superficial: but the enthusiasm of more perfect Adepts, whose reading and experience has been more extensive, has suggested a very different idea. Every character is by them imagined to convey an accurate description of the most essential quality of the substance which it represents.

It is impossible to advance very far in our inquiries on this subject; but perhaps some little light may be thrown upon it by an examination of the probable origin of the use of those few characters, which are common both to Astronomy and Chemistry.

It is well known that the signs, by which the chemists distinguish the seven principal metals, are by astronomers applied to denote the seven planets. If then it could be shewn, that these signs were used in the science of astronomy long before the chemists adopted them, it perhaps might be inferred with justice, that they were not suggested to the latter by any direct connection between the symbols and the substances signified by them:

but that they were first borrowed, for the sake of mystery, from the astronomers, and being thus introduced, probably led the way to the arbitrary invention of many others; which therefore do not admit of any explanation as being entirely the offspring of caprice.

Though the investigation of this point may appear to some more speculative than useful, yet I hope it will furnish both instruction and amusement, and therefore I presume to offer the following observations concerning it.

In the first place, it may be inquired upon what foundation the Chemists build their claim of priority in the use of these characters. Their advocates answer, that the characters express the qualities of the several metals to which they are assigned, reasoning in the following manner. *

The character of Gold, is a circle with a point in its center (\odot). A circle was always amongst the oriental nations assumed as the symbol of perfection and simplicity; and as gold is the most perfect and simple of metals, its nature is well expressed by this figure.

* A more extensive explanation of this pretended analogy is given by Dr *Shaw*. See his edition of *Boerhaave's Chemistry*. Vol. I. p. 68.

The character of Silver is a semicircle, or sometimes a double semicircle (D): by which it is implied, that silver is only half so pure, so simple, and perfect as gold ; but that if it were purged and refined from that impurity which debases its virtue, that is, if the inner part were properly applied to the outer, it would have the perfection of gold.

The type of Copper is a circle with a cross underneath (X), and denotes, that the body or basis of this metal is gold, though joined with some corrosive substance ; a cross or part of a cross being the character used by the ancient chemists to denote any corrosive or acrimonious solvent. Accordingly it has been asserted by some, that copper of all metals, silver only excepted, approaches nearest to gold, as its colour particularly shews ; and that it requires nothing but the separation of its corrosive to its perfection.

The symbol of Iron (Z) denotes gold at the base, but overcome, or, as the heralds say, *surmounted* with a corrosive quality, which not being so considerable in quantity as that of copper, and of a more volatile nature, is represented by a half-cross placed obliquely above the circle.

Tin is said to be half silver and half corrosive, which is expressed by a semicircle, and a cross laterally annexed (U) ; and the
adepts

adepts alledge, that tin approaches nearest of all the metals to silver.

The character of Lead (Pb) appears to be that of tin inverted. Here it is said, that although this metal has externally some resemblance to silver and tin; yet its corrosive quality is exceedingly powerful, and therefore the cross is in this figure put in the superior place above the semicircle. And to shew the propriety of this disposition, the alchemists observe, that lead by its corrosive property is most eminently useful in the scorification of the imperfect metals, and in the refinement of gold and silver.

The symbol of Mercury is composed of the circle of gold in the middle, the semicircle of silver above, and the cross at the bottom (☿); which combination expresses that it is intrinsically gold, as its weight seems to prove, but that it has externally the appearance of silver, and in reality the properties of neither: hence its purity is supposed to be debased by a corrosive property almost inseparably adhering to it; but if it could be separated, mercury would become gold.

It is hardly requisite to remark, that this explanation of these symbols has an immediate connexion with the doctrines of the alchemists,

alchemists, and supposes a much earlier origin and establishment of alchemy, than can be supported by any evidence of fact or reason, as I have in a former tract attempted to prove.

The pretensions of the Astronomers appear to be founded upon a more secure basis.

It is not perhaps possible to produce direct testimonies from ancient authors to shew, that these characters were used to discriminate the planets in the earliest astronomical observations; but it may be observed, that some authors, of no mean reputation, have asserted that their employment is of very ancient date; and though it cannot be referred to the very first ages, it has pretensions to a degree of antiquity much superior to any plausible date of the theories of alchemy. Scaliger, in his notes on Manilius, mentions as a proof that these characters are of very great antiquity, that we find the same symbols engraved on many very ancient stones and rings. * I am encouraged therefore to advance some arguments, which may perhaps render it probable, that they were originally invented and applied in a country, where astronomy received in no

Goguet's Hist. of the Sciences. Vol. II. p. 422.

small degree its first cultivation ; particularly if I can shew, that they have a real connexion with some remarkable circumstances of the philosophy, mythology, and even religion of that country. It is my intention, after this attempt, to endeavour to point out the circumstances, which led to their application and adoption in chemistry.

The names of the deities, appropriated by us to the seven planets, are evidently Roman. They were, with many religious ceremonies and institutions, borrowed by that people from Greece. It is more than simply probable, that the Greeks adopted them from the Ægyptians, as even their own historians acknowledge, that they derived the names of their gods, and the principal parts of their theology and mythology, from Ægypt. * This opinion, candidly advanced by Herodotus and many other authors, though opposed by some Greek writers and some of more modern date, seems now in a great degree to be admitted by all. † It is therefore in the mythology of Ægypt, that we

* *Herodot. Euterp.* 49, 50, 51, 58, &c.

† *Potter's Antiquities*, Vol. I. B. 2, Of the Religion of Greece, Ch. 1. *Abbé Pluche Hist. des Cieux*, L. 1. Ch. 2. et seq.

Banier's Mythol. Eng. Edit. Vol. I. p. 176. Vol. II, p. 158.

must

must seek for the origin of the characters that were employed to discriminate the planets in the ancient world, and have in later times been admitted into the most general use.

Astronomy was cultivated in all the oriental nations, particularly in Chaldæa, Phœnicia, and Ægypt, in the very earliest ages of which we have any record. Not only the uniform appearances of the fixed stars, but even the more irregular movements and revolutions of the planets, and their peculiar and characteristic circumstances of colour and splendor, were accurately marked and observed. It is probable, that the names, which in these early observations were given to the stars and planets, were derived from, or had an immediate relation to, the most sensible qualities of these stars. *Scaliger*, and the President *De Goguet*, have enumerated many of these appellations.* But the general use of these names was soon superseded by the gradual dissemination of the opinions of polytheism.

And the idea of a plurality of deities having been once suggested, it was extremely natural, that those splendid bodies, rolling in

* See *Scaligeri Comm. et Cast. in Manil. edit. Lutet.* p. 35.

De Goguet's Origin of the Sciences. Vol. I. p. 417, et seq.

the immensity of space by such regular and determined laws, should be considered as the habitations of, or consecrated to, those immortal beings, by whose immediate influence and superintendence the affairs of the world were conducted.* It was then, that the names of particular deities were appropriated to the planets, and hieroglyphic characters began to be employed in denoting the positions and phænomena of the celestial luminaries.

In the farther investigation of this subject, we must seek for our principal information from the mythology of Ægypt, or those Greek and Roman interpretations, which have obviously the same origin.

It is indeed very probable, not only that many of the original symbols of the Ægyptians are unknown to us, but that the history of others is obscured; and even the fables of the deities themselves confounded by the multiplied inventions of idolatrous superstition: but though positive proofs may not be in my power, a sufficient foundation for plausible conjecture may al-

* The origin of idolatry is by all theologists traced up to an admiration, gradually increasing to adoration, of the heavenly host, the sun, moon, and stars. See *Leland*, on the Christian Revelation. V. I. C. 3. *Banier*. V. I. B. 6.

most always be found, at least so far as to confirm the point, which I wish to establish, that the symbols of the planets were first applied in Ægypt, the very nursery of astronomy, and afterwards adopted in Greece, and more lately at Rome : that these symbols were formed from some well known circumstance in the history of those deities, by whose names the planets were distinguished; and that they were used in this science long before they were assumed by the alchemists.

In Ægypt the hieroglyphic mode of writing was used in the greatest extent, and connected both with the sciences and with religion. By this learned people a circle was employed to denote perfection, and particularly the infinite perfection of the Supreme Being, whom they denominated Osiris. His residence they conceived to be in the great luminary of the day; as from thence they perceived the continual emanation of light and heat, the most active instruments of the bounty of Providence, the principles of beauty, of vigour, of animation throughout the universe. Hence, by a very obvious application, a circle came also to be employed as the hieroglyphic of the Sun. The form of the crescent Moon

naturally pointed out the symbol, by which that planet is always typified; nor was she supposed to be destitute of a divine inhabitant, but was consecrated as the palace of the wife of Osiris, the common mother of mankind.

To explain the remainder of the astronomical symbols upon the same principle; it is necessary previously to remark, that polytheism, in its purest form, is nothing more than the deification of particular attributes of the Supreme Being, arising from the imbecillity of human nature, unequal to the comprehension of One All-perfect God.*

* I am happy to have, coinciding with mine, the opinion of a person of so much learning as Mr *Bryant*, † from whose system I shall take the liberty of transcribing a few lines: “Many learned men have been at infinite
“pains to class the particular deities of different countries,
“and to point out which were the same. But they would
“have saved themselves much labour, if, before they had
“bewildered themselves in these fruitless enquiries, they
“had considered, whether all the deities, of which they
“treat, were not originally the same; all from one source;
“branched out and diversified in different parts of the
“world. I have mentioned, that the nations of the east
“acknowledged but one deity, the Sun: but when they
“came to give the titles of Orus, Osiris and Cham, to
“some of the heads of their family; they too in time
“were looked up to as gods, and severally worshipped as
“the sun. This was practised by the *Ægyptians*: but
“this nation, being much addicted to refinement in their
“worship, made many subtle distinctions: and supposing

† *Bryant's Mytholog.* Vol. I. p. 305.

“that

The next deviation from the simple duty of religion was the deification of illustrious persons or heroes, whom superstitious traditions represented as deities, that came down from heaven for the comfort, instruction,

“ that there were certain emanations of divinity, they
 “ affected to particularize each by some title ; and to wor-
 “ ship the deity by his attributes.” I should be tempted
 to make a larger extract from this chapter, if I did not
 recollect, that the work is so well known, and so highly
 esteemed, that it would be needless. I shall only therefore
 refer to this chapter, as containing sufficient proofs of the
 identity of, at least, the *Dii majores* of the heathen world.
 The passages, which he has cited, strongly corroborate my
 sentiments, but they need not be again introduced. There
 is a passage in *Cicero’s* works, not noticed by Mr *Bryant*,
 which seems to prove plainly, that Jupiter and the Sun
 were considered as the same deity by the wiser part of man-
 kind even in the days of *Ennius*, though in spite of their
 knowledge and conviction they were led away by the ex-
 travagant absurdities of idolatry. “ Tum Lucilius, ne
 “ egere quidem videtur, inquit, oratione prima pars (sc.
 “ the existence of the gods). Quid enim potest esse tam
 “ apertum, tamque perspicuum, cum cœlum suspeximus,
 “ cœlestiaque contemplati sumus, quàm esse aliquod numen
 “ præstantissimæ mentis, quo hæc regantur? quod ni ita
 “ esset, quî potuisset assensu omnium dicere *Ennius*.

“ *Aspice hoc sublime candens, quem invocant omnes, Jovem,*
 “ illum vero et Jovem, et dominatorem rerum, et omnia
 “ nutu regentem, et, ut idem *Ennius*,

“ *Patrem Divûmque hominumque, et præsentem ac præ-*
 “ potentem deum. Quod qui dubitet, haud sane intel-
 “ ligo, cur non idem, sol sit an nullus sit, dubitare
 “ possit.”

Cicero De Nat. Deorum, L. II. 2.

See also the *Abbé Banier’s* account of the universal wor-
 ship of the sun, and particularly of the identity of that
 deity under all the various appellations of the heathen gods.
Banier’s Mythology, Eng. Edit. Vol. I. p. 182 and 484.

and

and protection of men. * In the explanation of the remaining symbols we shall find traces of both these systems of idolatry; and in general we shall have occasion to remark, that several opinions concerning the planets, and the deities to whom they were consecrated, which had their origin from the first system, were in after times, long after, explained by the second.

Hence we are not surprized to find, that the two planets, distinguished by a splendor nearest to that of the sun and the moon, were also supposed to be inhabited by, or at least were consecrated to the service of, the two chief deities under a different form and name. One of these planets is called Jupiter; and probably derived both its name and its symbol from that part of the Ægyptian mythology, which asserted, that when the gods in the war with the giants fled from the wrath of Typhon into Ægypt, they concealed themselves in the forms of various beasts, under which they were afterwards

* *Leland* on the Christian Revelation. Vol. I. P. I. Ch. 3, 4. *Montfaucon*, (and other authors,) speaking of the gradual introduction of idolatry into Ægypt, expresses doubts, whether it prevailed with all its attendant pomp and absurdity before the time of Moses. *Montfaucon*. Tom. II. p. 2. L. I. C. I. See also *Leland* Ch. Rev. Vol. I. P. I. Ch. 2. particularly, p. 71.

worshipped in that country ; and especially Jupiter, under that of a ram, at the celebrated Libyan temple of Hammon.* To this circumstance Lucan alludes in his description of the march of Cato, and his visit to this temple,

Ventum erat ad templum, Libycis quod gentibus
unum

Inculti Garamantes habent : stat certior illic
Jupiter, ut memorant, sed non aut fulmina vibrans,
Aut similis nostro, sed tortis cornibus, Hammon.†

And Ovid still more distinctly in his account of the wars of the gods,

Bella canit Superûm ; falsoque in honore gigantas
Ponit, et extenuat magnorum facta Deorum ;
Emissumque imâ de sede Typhoëa terræ
Cœlitibus fecisse metum, cunctosque dedisse
Terga fugæ : donec fessos Ægyptia tellus
Ceperit, et septem discretus in ostia Nilus.
Huc quoque terrigenam venisse Typhoëa narrat,
Et se mentitis Superos celasse figuris :
Duxque gregis, dixit, fit Jupiter ; unde recurvis
Nunc quoque formatus Libys est cum cornibus
Hammon ‡

* *Herod. Euterp.* 42.

† *Lucan. Pharsal.* IX. 511.

‡ *Ovid. Metam.* L. V. 313. See also *Lucian de Sacrificiis*, ad fin. *Luciani Op.* Bourdelotii. 186, 187. Representations of Jupiter Hammon with these insignia are very common :

As Jupiter therefore was so often worshipped under the form of a ram, or a figure with a ram's head, or at least wearing the horns of a ram; it is not improbable, that the symbol of this planet (see Fig. III. in the Plate. p.88.) was taken from these representations. It might originally be the perfect head of a ram, or only one horn. The cross annexed to it may be a remainder of the outline of the rest of the head; or, with more probability we may imagine, it was annexed at first to convey some particular information, and was afterwards retained in the figure, though the intention of its first application was forgotten. The Ægyptians, we are told, * expressed the different stages of the inundation of the Nile, by exposing columns

common: See particularly *Montfaucon Antiq.* Tom. I. Pl. 14. and Supplement, Tom. I. Pl. 20. *Mus. Florent.* Vol. II. Pl. 53. No. 4, 5, 6, 7. *Hunter's Medals*, T. 23. *Les Pierres Graveées de Mons. le Duc d'Orleans*, Vol. I. Pl. 6. p. 25. There is a statue of Jupiter Hammon in one of the niches on the stair case at Lord Pembroke's at Wilton, said to have been brought from a temple in Thrace, which was built by Sesostris. It has not only a ram's horns, but a ram on its shoulders.

* *Abbé Pluche Hist. des Cieux*, L. I. Ch. I. §. 8.

Banier likewise observes, that a cross is frequently a part of the symbols of the Ægyptian divinities, as appears from figures and obelisks still remaining; and he mentions, that in the celebrated *Mensa Isiaca*, both Osiris and Isis have such crosses in their hands.

Banier's Mythol. Eng. Edit. Vol. I. p. 563.

or

or poles, with one or more crosses upon them. And this cross was sometimes connected with other symbols to represent some other circumstance, either of the season, or the situation of the planets, which concurred with the inundation. Hence perhaps we see it annexed not only to this of Jupiter, but also to the symbols of Venus, Saturn, and Mercury. *

* As Jupiter was represented under this form, the horn of the ram came to be considered as the ensign of honour and power, and was assumed as an imperial distinction by many princes. Hence we see these ornaments on some of the medals, &c. of Alexander the Great, † who took particular pains to be thought the son of Jupiter Hammon; and considering his anxiety on this point, it may be wondered that we do not find them on more: but it should be remembered, that, though he wished to propagate this opinion among the oriental nations and in India, he was not very desirous of pressing the notion of his divinity on his græcian subjects; *Τοις δὲ Ἑλλήσι μετρίως καὶ ὑποφειδόμενος ἑαυτὸν ἐξεθεάζεν.* ‡ says *Plutarch*: and indeed it appears from a passage in *Curtius*, that he could not with safety urge this vain ambition to any great extent in Greece, as even his own Macedonians derided his folly, “*Et Macedones, assueti quidem regio imperio, sed majore libertatis umbra quam cæteræ gentes, immortalitatem assertantem contumacius, quam aut ipsis expediebat aut regi, averfati sunt.*” § These circumstances may sufficiently explain, why these honours of Ægypt are rarely seen on his græcian medals.

In all the medals of *Lyfimachus*, one of the immediate successors of *Alexander*, we see the *Cornua Ham-*

† *Goltzii Numism. Græc. Tab. 31. and Nonnii Comment. in hoc opus. p. 177.*

‡ *In Vit. Alexand. Plutarch. Op. omn. fol. Francofurt. 1519. T.I. p. 651. A.*

§ *2. Curt. Lib. IV. 31.*

That brilliant planet, which we call Venus, was also considered as sacred to the Queen

monis assumed.† Lyfimachus reigned in Thrace: and, from what has been said above, it appears that the worship of Jupiter Hammon was introduced into that country very early by the Ægyptian conquests, and prevailed to a very late period. †

There are also some medals of Marc Antony distinguished by these insignia: ‡ but these are not common, and were probably struck in Ægypt, when he gave himself up entirely to the influence of Cleopatra, abandoned the Roman habits and marks of nobility, and assumed the vestments and honours of Ægypt or his other oriental dominions.

The horns of different animals were indeed very anciently considered in the kingdoms of the East, as emblems of power and dominion. So many examples of this occur in the sacred writings, that it is not necessary to enumerate them, or to cite any particular instance. The late Bp of Bristol § has adopted the opinion of Ezechiel Spanheim (advanced in his work, *De præstantia et usu Numismatum antiquorum*), “that the source of this figure of horns for kingdoms, must be derived from the oriental languages, in which the same word signifies a horn, a crown, power, and splendor.” Is not this a proof, that these figurative expressions were really derived from, or nearly connected with, the hieroglyphic language of the earliest times, and thus with the very origin of the symbols of astronomy, which is the object of our present inquiry? Certain it is, however it may be explained, that the horns of the ram are more frequently chosen as this emblem, than any other; and that the animal itself was in several countries regarded with peculiar veneration. The horns of the ram are Daniel’s type of the united king-

* *Goltzii Numism. Tab. 36. Pl. 7. and Tab. 37. Pl. 1. Numism. Pembrochian. Part. I. Pl. 2. and Part. II. Pl. 65. Mus. Florentin. Vol II. Pl. 23. Vol. IV. Pl. 1.*

† The illustrator of the Duke of Orleans’ Gems, mentions also, that the Ptolemys sometimes assumed this Hammonian distinction. *Pierres Gravées de Monf. le Duc d’Orleans, Vol. I. p. 29.*

‡ *Cooke’s Med. Hist. Vol. I. Pl. 7.*

§ *Newton on the Prophecies. Vol. II. p. 25.*

of Heaven, by the Ægyptians named Isis, and known by almost innumerable other appellations in different countries. It would lead me into the depths of mythology to prove that the goddess intended by all these various titles was the same; and that the Venus of the Greeks and Romans was the Isis of the Ægyptians, whom we have already seen worshipped as the regent of the moon and the directress of the order and productions of the seasons, again celebrated as the more immediate source of animal fertility. * Accordingly the

doms of Persia and Media. † “It is observed,” (says Dr. Newton ‡) “in the preface to Mr Mede’s works, that it “was usual for the king of Persia to wear a ram’s head “made of gold, and adorned with precious stones instead “of a diadem (Ammian. Marcellin. Lib. 19. C. 1.). Bp “Chandler and others further observe, that rams heads “with horns, one higher and the other lower, are still to “be seen on the pillars at Persepolis (Chandler’s Vindication, Ch. 1. Sect. 4. Wetstein in Rev. xiii. 11.)” It may be added in illustration of this subject, that the ram is the first constellation of the zodiac; and it cannot be supposed, that this animal was assumed as the first sign without any meaning, and fixed in this distinguished place of the sun’s orbit, in *the first house*, || from whence the course of that luminary was supposed to commence.

* At sæcunda Venus cunctarum semina rerum Possidet. *Lucan. Pharsal. Lib. 10. 205.*

Innumerable are the proofs, which the industry of late mythologists has collected, to shew the identity of Juno, Luna, Diana, Astarte, Ashtaroth, and Venus. See *Bryant’s*

† *Daniel* viii. 20.

‡ *Newton* on the Prophecies, Vol. II. p. 27.

|| *De Goguet* Orig. of the Sciences, Vol. II. Dissert. 1. ad finem.

astronomers assumed as the symbol of this planet the Sistrum of the goddess Isis, which, we are told by antiquarians,* was a small round or oblong circle of metal crossed by iron rods with a handle, by which it might be held (see the plate Fig. VI. p. 88.), and that it was used at their feasts to mark by an exact cadence the movements of the songs and the dance. There was therefore a peculiar propriety in assuming this instrument as the symbol of that planet, which was supposed to be the residence of the goddess of mirth and love; and so often appears in its greatest splendor and beauty in those evening hours, when the labours of the day give

Mythology, Vol. II. p. 341. *Montfaucon's* Antiq. Tom. I. Part 2. Ch. 2. *Abbé Pluche* Hist. des Cieux, Ch. 2. § 11. *Montfaucon* speaking of the Ægyptian idolatry and of the identity of Isis and Venus &c. adds,

“C'est ce que a donné lieu de l'appeller *Myrionyme*, la
“Deesse à mille noms.”

Tom. II. P. 2. L. 1, 2.

Dr *Potter*, in his Antiquities of Greece, quotes the following sentence from some author, whom he does not name. Την Αφροδίτην ουρανίαν είναι μητέρα ορών. *Potter's* Antiq. Vol. I. P. 264.

* *Montfaucon* Tom. II. p. 287. its form particularly shewn, Pl. 108, 110, 114, 115, 116, 117.

Abbé Pluche Hist. des Cieux, Pl. vi. and xvii. and Chap. 2. Sect. 3. *Scaliger*, in his notes on Manilius, ut sup. supposes the astronomical character of Venus to be borrowed from a mirror with a handle.

place

place to mirth and joy, the song and the dance. *

* There are many beautiful allusions in the classics to the appearance of this planet, both as a morning and evening star, particularly the latter, when she is often represented as leading in her train refreshment, coolness, tranquillity, and love,

— cum frigidus aera Vesper

Temperat, et saltus reficit jam roscida luna,
Littoraque alcyonen resonant, et acanthida dumi.

Virg. Georg. III. 336.

Venerisque salubre fidus. *Luc. Phars. I. 661.*

Hesperè, qui cœlo lucet jucundior ignis? &c.

Catull. Carm. Nupt. 24.

Ἐσπερὲ, τὰς ἐρατὰς χερυσεὼν φαῖθ' Ἀφρογενείας,

Ἐσπερὲ κυανέας ἱερὸν φιλεῖ νυκτὸς ἀγαλμα, * * *

Χαίρει φιλοῦ καὶ μοι ποτὶ ποιεμένα κωμὸν ἀγοῦσι

Ἀντι σελαναιᾶς σὺ διδῶ φαῖθ'. *Mosch. Idyll. 7.*

Οἷος δ' ἀστὴρ ἡσὶ μετ' ἀστράσι νυκτὶ ἀμολγῶ

Ἐσπερὶθ', ὃς χαλλίστος ἐν οὐρανῷ ἴσται ἀστὴρ.

Hom. Il. x. 317.

There is a parallel simile to this in the *Æneid*, where the same planet is described in her other character of the morning star, with some additional circumstances of great beauty, and as the distinguished favourite of Venus,

Qualis, ubi oceani perfusus Lucifer undâ,
Quem Venus ante alios astrorum diligit ignes,
Extulit os sacrum cœlo, tenebrasque resolvit.

Æneid. VIII. 589.

As this planet is so often seen “hovering over the ocean’s brim,” either just risen from the waves, or just descending into them; may not this common appearance and position of her have given rise to the fable of the birth of Venus from the sea, and of her perpetual presidency over that boisterous element?

The character, attributes, and influence of Venus, are enumerated with peculiar elegance in the justly admired
exordium

In explaining the character of the planet Saturn we meet with another proof, that the different deities of the heathen world had their origin from the deification of the most obvious attributes of the One Supreme Being: for as in the former characters we traced the primæval ideas of the divine splendor and magnificence, benevolence and mercy; and saw him adored as the creator and preserver

exordium of the poem of Lucretius, which may be cited as a conclusive proof, that in the attempt above to reconcile the ancient opinion concerning her, as a goddess, with the phænomena of the planet, which bears her name, I have taken no very unjustifiable liberties.

Æneadum genetrix, hominum divumque voluptas,
 Alma Venus, cœli subter labentia signa,
 Quæ mare navigerum, quæ terras frugiferentis
 Concelebras; per te quoniam genus omne animantum
 Concipitur, visitque exortum lumina solis:
 Te, Dea, te fugiunt venti, te nubila cœli,
 Adventumque tuum: tibi suaveis dædala tellus
 Summittit flores, tibi rident æquora ponti,
 Placatumque nitet diffuso lumine cœlum.
 Nam simul ac species patefacta est verna diei,
 Et referata viget genitabilis aura Favoni;
 Aëriæ primum volucres te, Diva, tuumque
 Significant initum percussæ corda tua vi.
 Inde feræ pecudes persultant pabula læta,
 Et rapidos tranant amneis; ita capta lepore,
 Illecebrisque tuis, omnis natura animantum
 Te sequitur cupidè, quò quamque inducere pergis.
 Denique per maria, ac monteis, fluviosque rapaceis,
 Frondiferasque domos avium, camposque virentis,
 Omnibus incutiens blandum per pectora amorem,
 Efficis, ut cupidè generatim sæcla propagent.

Lucret. Lib. I. 1.

of

of the universe; so in this instance we have a demonstration of the reverence paid to his providence and wisdom, as the inventor of arts, and particularly of those, without which human life could not subsist, agriculture and the cultivation of the vine. This system seems to receive confirmation from a passage in the elegies of Tibullus, alluding to the Ægyptian mythology, by which it appears, that in the earliest times, that people attributed these beneficial inventions to the Supreme Being: *

* Primus aratra manu solerti fecit *Osiris*,
 Et teneram ferro sollicitavit humum :
 Primus inexpertæ commisit semina terræ,
 Pomaque non notis legit in arboribus.
 Hic docuit teneram palis adjungere vitem;
 Hic viridem durâ cedere falce comam.

Tibull. Eleg. L. I. El. 8. 29.

The lines immediately following shew, that the Roman and Græcian mythologists conceived the *Osiris* of the Ægyptians to be their *Bacchus*: but probably the doctrine, conveyed in the passage above cited, really referred to an older tradition concerning the origin of the necessary arts of life, delivered by immediate communication from Heaven to the first of men, but afterwards ascribed to deities, created by fear or gratitude, by ignorance or superstition.

Bacchus, however his character might afterwards be perplexed and confused, was originally only another name for the Sun, that is, *Osiris*; as *Ceres* was for the Moon, or *Isis*. This appears from these lines,

——— Vos, ô clarissima mundi
 Lumina, labentem cœlo quæ ducitis annum,
 Liber et alma *Ceres*. ———

Virg. Georg. I. 5.

See the Extract from *Bryant's Mythology*, p. 100.

but

but afterwards, when idolatry became prevalent, they feigned a distinct deity, and recorded his benevolence to mankind by placing in his hand the scythe or the sickle, the emblem of agriculture and harvest. As the character of this deity comprehended the attribute of superior wisdom and prudence, he was generally represented as an aged person bearing the emblem abovementioned : * and the astronomers, influenced by the prevailing opinions concerning him, appropriated as his residence that planet, whose aspect is dull and pale, its motion slow, and its revolution tedious ; and chose, as his symbol in the hieroglyphic writings of the science, the Falx,

* These insignia of the god Saturn are often mentioned by ancient authors : and the constant application of these, without an attempt to trace the propriety or origin of them any higher, was a sufficient reason for the astronomers, even at a much later period than that alluded to, to assume the sickle as the hieroglyphic of Saturn. *Juvenal*, in allusion to some traditions concerning him, says,

———— Priusquam
Sumferit agrestem, posito diademate, Falcem
Saturnus fugiens ——— *Juv. Sat.* 13. 38.

And *Ovid*,

——— Thuscum rate venit in annum
Ante pererrato Falcifer orbe deus.
Ovid. Fast. L. I. 233.

Representations of this deity, agreeable to this description, are common on ancient medals, &c.

See *Montfaucon's Antiq.* Tom. I. Pl. 5. and *Mus. Flor. Gemm.* Vol. III. Pl. 40.

with

with which their superstition had already ornamented his images. (see Fig. IV. p. 88.)

The deification of Mars* most probably had its origin from the strong impressions of the divine power and justice transmitted from the progenitor of the human race to all his descendants: but in later times, when a more corrupt system of religion had pervaded the world, this adoration was transferred through slavish fear to some irresistible tyrant, some oppressive conqueror, who claimed an apotheosis by the terror of his arms, and the severity of his victories. The god of war, thus created, was considered by astronomers as the regent of that planet, whose fiery aspect,† especially when he is

* Some writers, intimately versed in the oriental dialects, deduce the very name of this deity in all countries from certain words in the primitive languages, expressive of power, strength, might, &c.

Abbé Pluche, Hist. des Cieux, Liv. I. Ch. II. c. 20.

Abbé Banier's Mythology, Eng. Transf. Vol. II. p. 319.

Mr. *Bryant*, in enumerating the various titles of the sun, as the Supreme Deity, says, that at Petra, he was called Θεσσαρης, which is the same as Arcz. Θεσσαρης, τστ' εσι Θεος Αρης, εν Πειρα της Αρετας. Instead of a statue there was Λιθος μιλας, τετραγωνιος, ατυπωτος, a black square stone without any figure. *Bryant's* Analysis, Vol. I. 12.

† Hence the epithet πυρρως, which De Goguet insinuates, was a translation of the original name given by the first Ægyptian astronomers. Hence too the opinion, thus expressed by *Lucan*, that the winds and thunder were under the direction of this planet,

Habet ventos incertaque fulmina Mavors.

Pharsal. L. 10. 206.

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in his perigæon, and in opposition to the sun, corresponds well with the character of that deity by whose name he is distinguished. * And the symbol of the planet was therefore naturally formed from two of the most common instruments of war, the spear and the shield. † (See Fig. V. p. 88.)

* *Lucan* gives a very striking description of this planet, perhaps suggested by his appearance in this situation of his orbit, which occurs only once in eight or nine years. The poet is enumerating and explaining in the person of Nigidius Figulus, a celebrated astronomer, the omens which the heavens presented previous to the civil war; and amongst these he paints with great strength of expression the dreadful splendor of the planet Mars,

——— Tu, qui flagrante minacem
Scorpion incendis cauda Chelasque peruris,
Quid tantum, Gradive, paras? nam mitis ab alto
Jupiter occasu premitur, Venerisque salubre
Sidus hebet, motuque celer Cyllenius hæret,
Et cælum Mars solus habet. * * * *
Imminet armorum rabies, ferrique potestas
Confundet jus omne manu; scelerique nefando
Nomen erit virtus. *Luc. Pharsal. L. I. 659.*

† It is worthy of remark, that, as *Varro* relates, the Romans worshipped Mars under the simple form of a spear, long before they had invented any corporeal form or image of him. *Montfaucon's Antiq. Tom. I. B. 3. p. 125.*

Mars, ♂. Clypeus Martis cum Hastâ.
Bellice, depositis clypeo paulisper et hasta,
Mars ades. — *Ovid.*

Scaliger's Manilius Comm. & Cast. Page 35. Edit. Lutetiæ.

See the celebrated medal of Mars ad Iliam veniens, ad-
duced by Addison and Spence to explain the expression of
Juvenal in the 11th satire, v. 106.

Pendentis Dei ——— *Spence's Polymetis, p. 77. &*
Pl. VIII. f. 4. Sandby's Juvenal, Pl. XI. fig. 2.

The

The astronomical symbol of Mercury is obviously enough deduced from the Caduceus of that deity : but there are some particular circumstances, relative both to the planet and the deity, which differ from all the preceding, and may therefore require a little more time and attention.

It is very improbable, that this planet was discovered in the earliest æra of astronomy ; or within that period, when, according to the idea above suggested, the most simple form of polytheism prevailed, when the idea of the unity of the deity was not totally obliterated, and the different objects of religious adoration were little more than different names of the most striking attributes of the Supreme Being. It is generally, and very naturally, imagined, that of the planets Venus was the first taken notice of, on account of her extraordinary splendor. For a similar reason Jupiter and Mars were not long unnoticed, and the discovery of these might lead to that of Saturn : but Mercury was probably not known 'till long after these. The President De Goguet * is inclined to believe, that Mars was found to be a planet next after Venus ; then Mercury,

* Origin of the Sciences, Vol. I. B. III. Art. 2.

then Jupiter, and lastly Saturn; an order, which, at least with respect to Mercury, cannot be admitted, if we attend to the common phænomena of this planet. Mercury is the smallest of all the planets: his greatest elongation from the sun is not 23 degrees: he is therefore almost always obscured by the superior brightness of the sun's rays, though when seen through a telescope he appears very bright and splendid. There are many persons, who have never seen Mercury with the naked eye, who are well acquainted with the other planets and constellations: and as the ancient Ægyptians knew not the use of glasses, their situation was nearly similar. Some little allowance indeed is to be made for the advantages of their position on the globe, which is very favourable to observations on the planets, both on account of the serenity of the climate, and a smaller obliquity of the sphere: whence it is easier to discern Mercury disengaged from the rays of the sun. It was perhaps owing to this advantage, that he was ever discovered by them; and it may be reasonably concluded from the other arguments, that he was the last discovered of all the planets, and not till long after the rest.

Having

Having premised these observations, let us return to the history of the deity, whose name is given to this planet. And here I might be led into a very subtle disquisition; but the fables of this god are so complicated, that it requires no common abilities to simplify and explain them. I shall therefore only venture so far, as may be thought necessary to my present undertaking, and even that with the greatest caution and diffidence.

Almost all mythologists agree, that the origin of the fables of Hermes or Mercury must be sought in the history of Ægypt; that from thence the Greeks and Romans borrowed this deity; who, though they have transmitted him to us disguised with innumerable additional attributes or qualities, have still preserved the most essential part of his character unaltered, that he was the *messenger* and *interpreter* of the gods.

This character of Mercury seems to prove demonstrably, that he is not to be considered as a primitive deity (if I may use that expression), but as belonging to the second order, that class of illustrious men, whom gratitude, combining with superstition, honoured with an apotheosis.* Upon this foun-

* Diodorus Siculus, in his enumeration of the eight *Great Gods* of the Ægyptians, places Hermes last, expressly

dation we may proceed a little farther in inquiring into his origin and symbols.

Hermes or Mercury seems to have been a common name in the early periods of Ægyptian history; and perhaps, like that of Ptolemy in later times, and of Cæsar at Rome, having been rendered eminent by the abilities, the genius, or the actions, of one great man, was assumed, as a title, by his successors in the office, which he had filled. It is possible therefore, that the adventures and transactions of many persons may in these stories be brought together and centered into one history. To divide these, and to distribute the respective shares of fame and reputation to the proper claimants, is now an absolute impossibility; yet perhaps, from an exact examination of the materials, which have been delivered down to us, we shall have sufficient reason to believe, that the most striking parts of these fables are applicable only to the first Hermes.

He was also called by the Ægyptians Thoth, Theuth, Taut, Taautes, and Athotes; and is supposed, by many celebrated

persons adding, that he was so reputed by that people, tho' they were not so certain concerning the preccendency of the rest. *Diod. Sic. L. 1.*

Banier's Mythol. Vol. I. p. 105.

mytho-

mythologists, to have been Mizraim, one of the sons of Cham, who with his father and brethren settled in Ægypt after the deluge, and taught to his descendants those arts, of which they had preserved by memory some traces, when all other monuments of them were obliterated by the universal desolation. He is described, as the counsellor of Osiris, the interpreter of the will of the gods, the inventor of laws, * particularly skilled in the sciences, mathematics, geometry, and astronomy, † which he applied to the most useful and salutary purposes. ‡ He taught his subjects the mode of dividing, and ascertaining the boundaries of, their lands, that their property might not be confused by the inundation of the Nile. He instructed them to observe the motions of the heavenly

* *Diod. Sicul. L. I. 10. Banier. Vol. II. p. 365.*

† The exordium of *Manilius's* work is an address to Mercury, as the inventor of astronomy.

‡ From the remembrance of those important services arose the various epithets and additions expressive of his benevolence and wisdom, which we find so often annexed to his name; thus,

——— ἡλθ' εὐλαννης
'Ερμειας ——— *Hom. Odyss. 9. 322.*

'Ερμειας, Διὸς ἡὲ Δι' αὐτοῦ, δῶτορ ἔσσων.
Id. 335.

——— ἡδὲ εὐλαννης
'Ερμειας, ὅς ἐνι φρεσὶσι πδουχαλιμησι κεκασσι.
Hom. Il. v. 34.

bodies;

bodies; particularly those, which seemed to have most connection with the rising or retiring of the annual flood. Of these none was more remarkable than that bright star, which is known to us by the name of Sirius or the Dog star; for its first appearance in the morning, after it has been obscured by the sun, or, as astronomers say, its *heliacal* rising, * preceded at that time the commencement of the inundation only a few days, of which it was therefore naturally considered as the præcursor and monitor. † The gratitude of the people led them to give the name of their great instructor to this star, ‡ and also to the month corresponding

* The Nile begins to overflow its banks annually a day or two before the summer solstice; and, from the earliest observations of antiquity, recorded by Herodotus, down to the latest, which have been made by Pococke and Norden, no material variation has been remarked in the periods of the inundation. Compare *Herodot.* Euterp. 19. *Diodor. Sicul.* Lib. I. 22. De exundatione Nili. *Plinii* Nat. Hist. Lib. V. 10. *Lucan.* Pharsal. Lib. X. 219, et seq. *Prosper. Alpin.* De Med. Ægypt. Lib. I. C. 8. *Sandys's Travels*, B. 2. *Norden's Travels*, Vol. I. p. 55. *Pococke's Observations on Ægypt*, p. 198.

Allowance being therefore made for the motion of the fixed stars, which astronomers have called the precession of the æquinoxes, it will appear, without a minute calculation, that at the period, to which we are alluding, the heliacal rising of the Dog-star did precede the summer solstice a little time, exactly how long it may not be so easy to determine.

† *Abbé Pluche*, Hist. des Cieux, Vol. I. B. I. C. I. 7.

‡ *Id.* *ibid.*

to our September, * when the inundation was risen to its utmost height, and the fertility of the succeeding year was determined by those accurate experiments, † which perhaps Hermes himself taught them to conduct. The word Thoth or Tayaut signifying also a dog in the Ægyptian language, ‡ the name of that star was translated into some corresponding word in other languages, Κυν, Κυνωσφη, Canicula, Canis, the Dog-star. From the same source also sprung a great variety of Ægyptian hieroglyphic and mythological inventions. Hence

* *Cicero* de natura Deor. III. 22.

† *Alpin.* de Med. Ægypt. ut. supra.

‡ *Abbé Pluche* ut. supra.

The Greek name of this star Sirius is by their etymologists deduced from σιρω, exsicco, from its supposed influence in causing or increasing the extreme heat of the summer, and destroying the verdure of the fields,

———— tum steriles exurere Sirius agros :
Arebant herbæ et victum seges ægra negabat.
Virg. G. III. 141.

Te flagrantis atrox hora Caniculæ
Nescit tangere. — *Horat. Od. Lib. III. 13.*

See more particularly, *Plinii Nat. Hist. L. II. 40, 47. L. XVIII. 28.* Others derive it from Siris, an ancient name of the river Nile,

Σιρις ὑπ' Αἰθιοπῶν καλεῖται· οἱ δὲ Σιρην

ἐνναεῖται σρεφθεντι μετ' οὐνομα Νειλον εἶδεντο.

Dionysf. Geographia. Edit. Wells. 489.

See also *Plinii Nat. Hist. Lib. V. 10.*

This etymology connects the name with the subject of our inquiry, as the word may then be supposed to be taken adjectively Σειριος, qu. σειριος ασηρ, the star of the Siris of Nile.

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their

their images with the head of a dog, κυνοκεφαλοι and Anubis, and sometimes Hermanubis, to which in after times they paid divine honours, as their guardian and monitor. * But as the superstition of the Ægyptians had no limitation, they were persuaded by their gratitude to constitute a different deity from every attribute or quality of a favourite character. Thus they formed another object of adoration from the fable of Hermes, as the *messenger of the gods*, and the *interpreter of their will*. They gave him an active elegant form, and the graces of youth; decorated him with emblems of agility and speed, † and placed in his hand the Cadu-

* Latrator Anubis. *Virg. Æn.* VIII. 698. *Propert.* L. III. El. II. 41. See the account and representations of Anubis in *Montfaucon's Antiq.* Tom. II. Part II. p. 312, particularly in Plate 128 of that Volume is a figure of Anubis with the Caduceus and a sphere.

† It is in this capacity, and with these insignia, that we meet with him in the Greek and Roman classics, of which the following amongst many examples may be adduced;

Ἑρμεία, σοὶ γὰρ τε μάλιστ' ἀφίλιτον ἐστὶν
 Ἄνδρ' ἐταίρεισσι, καὶ τ' ἐκλυες, ὧ κ' ἐδελήδα,
 Βασκ' ἰδί, &c. &c.
 Ὡς ἔφατ'· ἔδ' ἀπῆλθε διακτορὸς Ἀργεῖφροντῆς·
 Αὐτὴν ἔπειδ' ὕπο ποσσὶν ἐδήσατο καλαὶ πεδίλα,
 Ἀμβροσία, χρυσεῖα, τὰ μιν φέρον ἦμεν ἐφ' ὕρην,
 Ἡδ' ἐπ' ἀπειρονα γαίαν, ἅμα πνοιῆς ἀνεμοῖο·
 Εἶλετο δὲ ῥαλδὸν, τῇ τ' ἀνδρῶν ὀμματα δέλγει,
 Ὡν ἐδελει, τὸς δ' αὐτὲ καὶ ὑπνωόντας ἐγείρει·

Iliad. ω. 334. & *Odyss.* 43.

Εγδα

ceus, that ensign of office, of magistracy, of dominion, which princes, as the vicegerents of the gods, are entitled to sustain.*

It was a sceptre (agreeable to the most

Ενθα μοι Ἑρμῆας χρυσοῤῥαπισ ἀντιβόλησεν
Ερχομένῳ πρὸς δῶμα, νηηνὴ ἀνδρὶ εἰκώς,
Πρῶτον ὕπνῃντῃ· τῶπις χαρίεσται ἦεν.

Odys. x. 277.

Sive mutatâ juvenem figurâ

Ales in terris imitatis, almæ

Filius Maïæ. ——— *Hor. Od. L. I. 2, 41.*

Omnia Mercurio similis, vocemque, coloremque,

Et crines flavos, et membra decora juventæ.

Virg. Æn. IV. 598.

Interpres Divum, Jove missus ab ipso.

Id. 356 and 377.

Constitit ante oculos, actus velocibus alis,

Atlantis magni Pleïonesque nepos.

Fas vidisse fuit; fas sit mihi visa referre;

Inque Dei digitis aurea virga fuit.

* * * * *

Obstupui, gelidusque comas erexerat horror;

Cum mihi, pone metum, Nuncius Ales ait.

Ovid. Ep. Paris Helenæ. 61.

And lastly that most complete description of him in the *Æneid*,

Dixerat. Ille Patris magni parere parabat

Imperio: et primum pedibus talaria nectit

Aurea; quæ sublimem alis, sive æquora supra,

Seu terram rapido pariter cum flamine portant.

Tum virgam capit, hac animas ille evocat orco

Pallentes, alias ad tristia tartara mittit,

Dat somnos adimitque, et lumina morte resignat.

Illa fretus agit ventos, et turbida tranat

Nubila. ——— *Æneid. IV. 238.*

See *Abbé Pluche's* observations on the Caduceus. *Hist. des Cieux*, Vol. I. B. I. Sect. 26.

simple and original form of sceptres,* which were only a strait piece of wood or branch of a tree, afterwards ornamented with various additions either of splendor or utility) round which two serpents twined. The serpent was in a very early period assumed as an emblem of wisdom, and became proverbially so in the languages of the east. † The sceptre alone was an emblem of power, and therefore connected, as in the Caduceus, with the serpent, was a compound emblem of a good government, supported by authority and directed by prudence. And in still

* Ναι μα τοδε σκηπτρον, το μεν ουποτε φυλλα και οζυς
 Φυσει, επειδη ωρεσται τομην εν ορεσι λελοιπεν,
 Ουδ' αναδηλησει· πει γαρ ξα ε χαλκῳ ελεφε
 Φυλλα τε και φλοιον· νυν αυτε μιν υιες Αχαιων
 Εν παλαμης φορεσι δικαστοι, οϊτε θεμιστας
 Περσ Διῳ ειρναται·

Hom. Il. α. 234.

Ut sceptrum hoc (dextra sceptrum nam forte gerebat)
 Nunquam fronde levi fundet virgulta nec umbras :
 Cum semel in sylvis imo de stirpe recisum
 Matre caret, posuitque comas et brachia ferro :
 Olim arbos, nunc artificis manus ære decoro
 Inclusit, patribusque dedit gestare Latinis

Virg. Æn. L. XII. 208.

† “Be ye wise, as serpents,” *St. Matthew*, x. 16. How extensively a reverence of the serpent, and an opinion of its wisdom, prevailed in the East, is shewn by Mr *Bryant's* account of the Ophiolatria. See *Bryant's Analysis*, Vol. I. p. 473.

later

later times, when their astronomical observations detected that planet, which is nearest to the sun, they fancied in his movements a great analogy to the character of their favourite Hermes. * Like a faithful messenger and servant of Osiris (the Sun) he keeps close to his superior, never moves from him but a small distance, and returns again quickly, as if always attentively engaged in the execution of his commands. They therefore consecrated it to Hermes, and, as its symbol in the hieroglyphic writings of astronomy, assumed the Caduceus. † (See Fig. VII. p. 88.)

* *Lucan* calls him *Cyllenius celer* (*Pharsal.* L. I. 663.), in another place the same poet speaks of him as having an influence on the great water,

— immensæ Cyllenius arbiter undæ.

Pharsal. L. X. 211.

Perhaps this part of his character may have a distinct reference to what has been said above concerning the connection between the rising of the Dog-star and the inundation of the Nile; for the Nile was anciently called *Oocæmes* or *Oceanus*. *Diodor. Sicul.* Lib. I. 11.

Some writers have imagined that the fiction of the wings affixed to the cap, feet, &c. of Mercury was suggested by the rapid motion of the planet which bears that name. *Ovid.* *Metamorph.* *Notis Var. ed. Cnippingii.* Lib. XI. 312. *de Alipede Deo.*

† For a more particular history of Mercury and Anubis, and representations of their images, &c. See *Montfaucon's Antiq.* Tom. I. L. III. 8 and 9. et seq. and *Supplement.* Tom. I. L. III. 6. with the annexed plates, and also Tom. II. P. II. L. I. 16. and Pl. 127 and 128.

Whether

Whether this attempt to explain the origin of these symbols be admitted as preferable to that of Scaliger, * or not ; it cannot but appear from what has been said both by him and myself, that the credit of their invention and prior application must be ascribed to astronomy.

I shall in the next place endeavour to point out some circumstances, which might induce the chemists to appropriate them to their art. As in this application I shall be very often obliged to have recourse to conjecture, I must previously solicit the indulgence and favour of those, who may think these dissertations worthy of their perusal.

The peculiar splendor of the sun and moon had without doubt been long noticed ; and long before the introduction of alchemy (whatever æra of its introduction we assume) the language of poetry had discriminated the former by epithets borrowed from the analogous brightness and colour of gold, that of the latter from the purer white lustre of silver. A few instances out of many are in-

* *Scaliger's* explanation of these characters is as follows, Characteres, quibus vulgo designantur Planetæ, sunt hi ;
 ♄. Saturnus, Falx Saturni. ♃ Jupiter, Fulmen Jovis.
 ♂. Mars, Clypeus Martis cum hastâ, ☉. Sol, non indiget explicatione. ♀. Venus, Speculum Veneris. ☿. Mercurius, Caduceus Mercurii. ☾. Luna. *Scaliger.* in *Manilium Notæ et Castig.* Ed. Lutet. 12° p. 35.

serted

serted in the margin. * The frequent use of these epithets might easily lead an enthusiastic mind to conceive, that a real analogy and correspondence subsisted between these planets and metals, which by the warmth of a fertile imagination might seem to receive confirmation from innumerable circumstances, and ultimately lead to the employment of the same expressions for both, and the application of the same symbolical characters for the metals, which had before been appropriated to the planets. Hence the circle of the sun was assumed as the type of gold; and of silver the crescent of the moon.

The number of the metals known at that time agreeing exactly with that of the planets led to an extension of this analogy to

* *Aurati Solis Radii. Virg. Æn. XII. 64.*

Solis aurata corona. Stat. Theb. III. 414.

Sol Auricomus. — — Val. Flac. IV. 94.

Sol Aureus, — — Virg. Georg. I. 232, G. IV. 50.

And *Ovid*, of the chariot of the sun, says,

*Aureus axis erat, temo aureus, aurea summæ
Curvatura rotæ. — — Metam. II. 107.*

Niveos Luna levarit equos. Ov. Fast. IV. 374.

Nec candida cursum Luna negat. Virg. Æn. VII. 8.

Faveas, Dea candida, dixi. Ovid. Leand. Heron. 61.

Fulges radiis argentea puris, Id. 71.

the

the whole : and every metal was easily found to have a relation to one or another of the seven, and received, as its mark, the astronomical character.

Some particular circumstances, which might give a foundation for these suppositions, shall now be mentioned.

Copper was principally, or at least in the most considerable quantities, found in the island of Cyprus; and the manufacture of brass was not only invented there, but carried on to a degree of perfection unknown in other countries; insomuch that, we are informed by authors of credit,* either the metal derived its name from the island, or the island from the metal.

As this island was supposed to be peculiarly under the dominion of Venus,† an

* “ Fit (nempe Æs) et ex alio lapide, quem chalciten vocant in Cypro, ubi prima fuit æris inventio :

Plin. Nat. Hist. L. XXXIV. 2.

To the truth of which assertion *Harduin* subjoins the following testimonies,

Arist. Lib. V. Hist. anim. Cap. 18. p. 608, Εν δὲ Κυπρῳ ὅτι ἡ λιθὸς χαλκίτις κρείττω. Festus. Ærosam appellarunt antiqui insulam Cyprum, quod in ea plurimum Æris nascatur.

† Κυπρος δ' εἰς αἰγας Παμφυλίας ἐνδοξὴ κολπὴ
Κλυζέτ' ἐπιθρατον αἶσυ Διωνάϊας Ἀφροδίτης.

Dinoyf. Geog. Ed. Wells, 1240.

O Venus, regina Cnidi Paphique,

Sperne dilectam Cypron. *Hor. Od. Lib. I. 30. 2.*

See

obvious connection was found, which might justify the application of the symbol of the planet Venus to copper.

The use of Iron, in framing the instruments of war, formed so striking a relation between this metal and the god Mars, that we need not inquire why the character of his planet was assumed to distinguish iron.

The mobility and unfixable nature of the metallic fluid, Quicksilver, was naturally, by minds thus disposed to form analogies, compared with the rapid movements of the planet Mercury; and hence both his name and astronomical symbol have been appropriated to the metal.

On the other hand, the slow motion of Saturn, the coldness of his situation, so far

See also *Hor. Od. Lib. I. 31. Lib. I. 19. 9. Lib. III. 27. 11.*

Ἡ δ' ἄρα Κυπρον ἱκανὲ φιλομειδῆς Ἀφροδίτη,
 Ἐς Παφον' ἐνθα δὲ οἱ τέμενος βῶμος τε θυεῖς.
 Ἐνθα δὲ μιν χερσὶν λουσαν, καὶ χερσὶν ἔλαιον
 Ἀμύροτον, οἷα θεοὺς ἐπὶ νηνοῖσιν αἰὲν ἔοντας.
 Ἀμφὶ δὲ εἴματα ἔσαν ἐπηράτα, δαῖμα ἰδιδται.

Hom. Od. lib. 9. 362.

*Ipsa Paphum sublimis abit, sedesque revisit
 Læta suas; ubi templum illi, centumque Sabæo
 Thure calent aræ, fertisque recentibus halant.*

Virg. Æn. I. 419.

See also the description of the temple of the Paphian Venus, when visited by Titus. *Tacit. Hist. L. II. 3.*

R

removed

removed from the sun, and his dull aspect, (all which obtained him the epithets of frigida, gelida, rigens, and others of like import, *) presented a resemblance to the obvious and external, as well as the internal and medicinal qualities, of Lead, sufficient to countenance the supposition of a relation between that metal and the planet, and to authorize the application of the symbol of Saturn to lead.

The analogy being extended thus far without any great violence, the only remaining symbol of Jupiter was applied to Tin, for which the bright splendor of the planet and the metal might seem to afford a plausible pretence. † The propriety of this application may perhaps be thought to derive some confirmation from the following conjectures.

* He is called *συγρος κροτος* by an old Greek poet quoted by *Scaliger*. Cast. et Not. in Manil. ut sup.

Summo si frigida cœlo
Stella nocens nigros Saturni accenderet ignes.
Lucan. Phars. L. I. 651.

Frigida Saturno glacies, et zona nivalis
Cessit. Id. L. X. 205.

See also *Plin. Nat. Hist. L. II. C. 6.*

† Homer distinguishes tin by the same epithet, *φαιρος*, which he uses when speaking of the splendor of the moon and planets. Compare *Iliad. ε. 551*, with *Iliad. ψ. 361*.

Tin

Tin was not found in any of the countries of the ancient world, that were commonly known and easy of access. It was imported by the Phœnicians from some of those regions, where they traded in their remote voyages beyond the pillars of Hercules: particularly it was said to be brought from some islands, which they call Cassiterides. Whether the metal received the appellation of Cassiteron or Cassiteros, as Homer calls it, * from these islands, or they were so named from the metal, is uncertain; and it is scarcely less undetermined, what these islands were, and where they were situated. Some place them on the western coasts of Spain, or Portugal, or Africa. Others suppose them to have been the Scilly islands near the Land's end in Cornwall. † It is not therefore impossible, that the Phœnician navigators, who were always particularly secret ‡ concerning the place, from whence they obtained the

* Iliad. ψ. ut sup.

† In *Wells's* Dionysius, v. 1110, it is asserted positively, that the Cassiterides were the Scilly islands, and that the ancients denominated them from the tin, which they produced. And Dr *Borlase* admits this position without any doubt, but insinuates further, that probably the original name was derived from a word in the Phœnician language of similar sound and import. *Borlase's* Antiq. of Cornwall, Ch. 7.

‡ See *Borlase's* Antiq. Ibid.

tin, might assert, that it was discovered to them by the God of the sea, not the Neptune of the Greeks and Romans, of whom the oriental nations * seem to have formed no idea, but the more ancient Oceanus, who is often called the Father of the gods, and was in Ægypt, and probably in Phœnicia, certainly in Greece, † frequently confounded with Jupiter; at least the attributes of the latter are very frequently applied by their old writers to the former. Hence the Greeks and Romans might understand, that the Phœnicians ascribed their discovery of tin to the favour of the Supreme Being, or as it might be interpreted, Jupiter: which may be thought the more plausible, if we recollect

* Particularly the Ægyptians, *Herod.* Euterp. 50. and *Melpom.* 188. where it is expressly asserted, that the Greeks and Romans adopted Neptune from Africa, from the inhabitants of the country bordering on the Palus Tritonis near the Syrtis minor, not far from Carthage.

† Ωκεανον καλεω, 'πατέρ' αφδιτον αιεν εοντα,
Αθανατων τε Θεων γενεσιν, θνητων τ' ανθρωπων.
Orph. Hymn. 82,

Ωκεανος δ', οαπερ γενεσις παντεσι τετυκται.
Hom. Iliad. ξ. 246.

Ωκεανον τε Θεων γενεσιν. *Id.* 200.

Οσιγν Ωκεανον. *Plut.* in *Isid.* et *Osirid.*

See this point further illustrated in Mr *Bryant's* examination of the character of the patriarch Noah. *Analysis*, Vol. II. 251.

that

that the inhabitants of the Scilly islands considered themselves as the offspring of a Deity, who, tho' by some confounded with Pluto*, might perhaps by others with more propriety and accuracy be regarded in the same light as the Jupiter of the Greeks and Romans, the Father of the Gods.

* *Cæsar* indeed says^a, that the Gauls considered themselves, as the descendants of Dis or Pluto; and Dr *Borlase* has from the authority of this first historian of Britain asserted the same of the Inhabitants of the Scilly islands^b.

It would be presumptuous to oppose my feeble opinion to the testimony of writers so incontestably superior; but, if I might be allowed to propose a question on this subject, I would ask, if there is not great reason to doubt, whether either the Gauls or the Britons had any idea of the Deity, whom the Greeks and Romans worshipped under the name of Pluto? And it is hardly probable, if we reason from the known principles and general progress of idolatrous worship, that they should trace their origin up to a Deity, a Prince, or a Chieftain, of whom we find no traces in their religious superstitions. It is not impossible, that *Cæsar*, perceiving a strong analogy and resemblance between the dark, inaccessible, mysterious ceremonies of the Druid worship in their consecrated groves^c, and the solemnities, with which Pluto was honoured in his own country^d, might conceive, when they traced their descent from the object of these extraordinary rites, that they considered Pluto as their common father.

To shew that this conjecture is not absolutely inadmissible, it may be remarked, that Pluto was a deity (if I may so say) almost entirely Grecian, and yet neither that people nor the Romans accurately distinguished his attributes and qualities, for he was often even by themselves

^a *Cæsar's* Comm. de B. G. L. vi. 16.

^b *Borlase's* Antiq. of Cornwall, Ch. 5.

^c *Lucan.* Pharf. III. 399. *Borlase's* Antiq. B. II. C. 17.

^d *Hæzer's* Mytholog. Vol. III. P. 45.

confounded

If it were possible to prove, that any traces of such an opinion as this subsisted at the time, when the Alchemical doctrines became prevalent, we should not be at a loss to determine, why tin was by them distinguished by the symbol of the planet Jupiter.

Before I conclude, I will take the liberty to mention that in the last part of this dissertation, though I have derived some assistance from the Greek classics, I have endeavoured

confounded with Jupiter. Thus he is called by titles nearly allied to those of Jupiter, *Αγεπλάς*, *Αγεταυδής*, *Jupiter Inferus*, *Niger*, *Stygius* and *Diespiter*^a. It is well observed by the very ingenious Mr *Burges*, that this last expression is not to be deduced, as many etymologists incline, from *Dici pater*, but from *Deus* or *Dius pater*^b. It is obvious too from numerous observations collected by *Montfaucon*^c that the *Ægyptians* in the character of *Serapis* confounded the attributes of Jupiter and Pluto. Hence, in conformity to the system which has been advanced above concerning the origin and progress of polytheism, it may be imagined, that these various titles, when simplified, were only different denominations of the One Supreme Being, assumed from the different departments of his universal dominion. And therefore when the Gauls and Britons, in a language very imperfectly understood by their conquerors, alluded to a remote origin from the object of their mysterious devotion, the Romans discovered the character of Pluto in a description, which probably referred to a much higher source, suggested by the universally-prevailing traditions concerning the first creation of man by the Almighty Word.

^a *Montfaucon's Antiq.* Tom. I. L. II. C. 9.

Banier's Mythol. Vol. III. p. 45.

^b *Essay on the Study of Antiquities.* P. 69.

^c *Montfaucon's Ant. Supplm.* T. II. L. vi. C. 6.

voured to draw my illustrations principally from the Roman, and those the most obvious and familiar authors; supposing that these were most likely to be known, if any were known, to the Alchemists, and might have some influence upon their judgment, when they adopted the symbols of the ancient Deities (first invented and applied by the astronomers to the several planets) and introduced them into Chemistry, as types of the several metals.

T R A C T I I I.

OBSERVATIONS on the DISEASES prevalent in the SOUTH SEA ISLANDS, particularly the LUES VENEREA, with some Remarks concerning its first Appearance in Europe.

IT will probably appear extraordinary at this time to revive the discussion of a subject, so often debated, and (in the judgment of most persons) so satisfactorily dismissed; a subject, on which so many volumes have been written, that it might be well supposed, there could not remain any room for doubt. This perfect conviction, I imagine, has persuaded the medical world to pass over with inattention the observations

tions of a very sagacious inquirer into the operations of nature, made in some of the late voyages round the globe, conducted under the auspices of the British nation. I allude particularly to those of the very ingenious Dr Forster, concerning the antiquity and origin of the Venereal Disease in the South Sea islands, and his collateral observations on the æra of its appearance in Europe. Though I cannot perfectly agree with the learned writer in his opinion on these subjects, I am confident, from my knowledge of the candour which distinguishes his character, that he will pardon the liberty I have taken in thus expressing a dissent, which I shall give in very few words without any intention of disrespect to a writer, to whose services in the cause of literature in general, and particularly in the various branches of natural history, the learned world has so many and great obligations.

After much debate and a great variety of arguments on each side of the question, the whole force of the evidence concerning the first appearance of the Venereal Disease seemed to have been collected and brought to its proper point of view by Astruc. And the medical world, since the publication of his work, has almost universally acquiesced in
the

the opinion, that this disease is of modern date, that it first appeared about the period when Columbus returned from his first voyage, and that, previously to that date, there is no account of any disorder which can with truth be classed under the same denomination. He argues from the silence (as far as relates to this subject) of the physicians, the historians, the poets, who preceded this period. He explains the few passages of ancient authors, which might give any plausibility to an opposite conjecture, and shews their relation to diseases of a very different type. He evinces the diagnosis between this disease, and the elephantiasis and lepra of the ancients, with which it had been sometimes confounded. He gives the most authentic narration of real facts concerning its first appearance in Europe, between the years 1492 and 1496, and not before. He confutes the arguments of those, who think they can produce facts of an earlier date, especially some, which are borrowed from the writings of the surgeons of the thirteenth, fourteenth, and the earlier part of the fifteenth, centuries, and more particularly, one of a much later date in the Philosophical Transactions of 1718, the testimony of William Becket a surgeon at

S London,

London, who took great pains to collect all the arguments which could be adduced to prove the antiquity of this disease, especially from the accounts handed down concerning the *arsura* or *perilous infirmitie of brenning*. He destroys the fictions of theory, the offspring of speculative and fantastic imaginations, concerning the origin of this extraordinary calamity.

It cannot be thought necessary by those, who possess the smallest degree of medical knowledge, to re-produce his arguments, as the work itself is so popular, that it must be familiar and well known to almost every student. I have only said thus much to shew, that the opinion of the greater part of physicians, that this disease was perfectly unknown in Europe before the year 1493, has no slight degree of foundation.

Of late years the old arguments on the opposite side of the question have been revived, particularly in consequence of some observations made in the voyages to the South Seas.

It is well known, that since the peace of 1763, several ships of the English and French nations, especially of the former, have been sent into the South Seas with the intention of making physical and astronomical

mical observations, both by land and sea, in those southern latitudes. The sailors of these ships had communication with the women of the new-discovered islands; and from this intercourse the Venereal Disorder made its appearance both in the ships and on shore. The two nations have, not obliquely, charged each other with the eternal disgrace of letting loose the Fiend upon the mild and innocent inhabitants of those islands, whose hospitality deserved a better return, as their benevolence was free from deceit, and their caresses the tribute of love and simplicity.* It may not be easy to vindicate this nation from their part of the charge of this guilt (shall I call it) or rather misfortune. Dr Forster attempts to wipe off the whole of the ignominy by tracing the origin of the

* “Mox, ubi *Taitæ* vasto jacet insula ponto

“Hospita terra capit : non illis effera morum

“Asperitas, sed blanda quies, atque otia cordi :

“Et faciles nymphas, passim per amœnâ vireta

“Ludentes molli gestu, cultuque decore,

“Commendat formâ arte carens, et gratia simplex.”

These elegant lines are extracted from a poem on the subject of these discoveries, which was honoured with the Chancellor's prize at Oxford in 1773, written by Mr Lowth, eldest son of the Bishop of London, then Fellow of New College.

By this citation I might be led to offer a tribute of affection and regard to the memory of the amiable writer, which, even those who knew him not, would at least excuse. Yet why should I revive sensations of unavailing regret? why

disorder both in these islands and in Europe to the remotest times, and deducing it from natural causes, which have subsisted from a very early period of history. Before I give any account of this attempt, I shall shortly state the order in which the several voyages were made.

The first of these voyages was made in 1764 by Capt. (since Admiral) Byron in the *Dolphin* man of war, in company with the *Tamar* frigate. He made very few discoveries amongst the islands, to which I allude, and returned in the spring of 1766. In the month of August following, Capt. Wallis in the *Dolphin* and Capt. Carteret in the *Swallow* sailed from Plymouth on the same ad-

should I recal to remembrance (if it can be forgotten), how cruelly his premature death extinguished the fond expectations of his admiring friends, (formed both from the early dawn of his native elegance of mind, and from his acquired accomplishments), and destroyed all their hopes of seeing in him, supported and extended, the reputation of a name, already endeared by innumerable ties to the votaries of virtue and literature?

————— *Ingentem luctum ne quære tuorum :
Ostendunt terris hunc tantum fata, neque ultra
Esse sinunt. * * * Manibus date lilia plenis :
Purpureos spargam flores, animamque ———
His saltem accumulem donis, et fungar inani
Munere, —————*

Virg. Æn. VI. 868 and 883.

venture,

venture. Capt. Wallis discovered, with many other islands, Otaheite,* which he named King George the Third's island, on Thursday June 18. 1767. He left it July 27, and returned to England, Friday May 20. 1768. The observations of Capt. Carteret have but little connection with the subject of this dissertation. On the 21st of November 1766, M. Bougainville, a French officer of distinguished merit, sailed from Brest upon a similar voyage. He touched at Otaheite on the 6th of April 1768, (which was long after Capt. Wallis's departure thence), refreshed his crews in the very port which Capt. Carteret had lately left in New Ireland, and returned to Europe in March 1769, much about the same time as the Swallow sloop, which he overtook almost in the Channel.

At the return of Capt. Wallis, the Royal Society of London preferred a memorial to the King, representing the advantages, which would accrue to astronomical science, if an accurate observation of the transit of Venus over the sun in June 1769 could be taken in

* The orthography of the name of this island has undergone many changes. It is called by Bougainville Taiti, by Dr Forster O-Taheitee, by Capt. Wallis and Capt. Cook Otaheite, which mode of spelling I have adopted, except in the quotations from the other voyages.

one of these islands in the South Seas. His Majesty condescended to attend to their petition; and the Endeavour with Capt. Cooke, Mefs. Banks, Solander, and other select philosophers and natural historians on board, properly equipped and furnished, was on the 26th of August 1768 dispatched to the South Seas.* This voyage having entirely answered the intention for which it was planned, and excited the curiosity of the nation; a second expedition was in 1772 sent into the same latitudes. The two ships employed in this voyage viz. the Resolution and the Adventure, were under the command of Commodore Cooke. On board the Commodore's ship the Resolution, were Dr Forster, a gentleman previously to this expedition distinguished by his skill in natural history, and his son, who had likewise given several proofs of a successful attachment to the same pursuits. They were expressly commissioned in this voyage to collect, describe, and draw objects of natural history. We are not therefore surprized to find, that Dr For-

* They were ordered to proceed immediately to Otaheite, and after the astronomical observations should be compleated, to prosecute the design of making discoveries in the south pacific ocean. The Endeavour returned to England on the 12th of July 1771.

ter, in relating the events and discoveries of this expedition, has paid a particular attention to the health and diseases of the sailors; as well those, which may be supposed to have originated from the climate, the voyage, and circumstances of life, as those that were introduced amongst them by more direct contagion, and by communication with the natives of the islands.

Before I make any remarks on this account, I shall give an abstract of that part of his narrative, which relates to the subject of this dissertation.

He begins his account at an earlier period than his own voyage, that his investigation may be more accurately and satisfactorily conducted.

After describing a disease resembling the leprosy, which is sometimes seen in these islands, he is led to speak of the Venereal Disorder, on which he makes the following observations. *

“ When Capt. Cook came, in the year
 “ 1769, in the Endeavour to O-Taheitee, he
 “ found that half his crew, when he left
 “ the Society Isles (of which O-Taheitee is
 “ the principal and most central) were in-

* Observations made during a voyage round the world by *John Reinold Forster*, LL. D. P. 488.

“ fected

“ fected with the Venereal Disease, * and it
 “ was then suspected, that M. Bougainville’s
 “ ships crew had communicated this disease.
 “ Mr de Bougainville in his turn suspects the
 “ English in the Dolphin to have first intro-
 “ duced it : † and the gentlemen in the Dol-
 “ phin assert, that they never had one man
 “ infected with the least Venereal symptom,
 “ whilst they were at Taheitee or imme-
 “ diately afterwards. ‡ When we came to
 “ Q. Charlotte’s sound, in New Zealand, in
 “ 1773, we had been out at sea for at least
 “ five months ; none of our sailors had any
 “ symptom of this disease, which could hardly
 “ lie dormant for such a length of time :
 “ since, from our leaving the Cape of Good
 “ Hope, they had been eating salt-meat and
 “ salt-pork plentifully, had no greens all
 “ that time, had indulged freely in the use
 “ of spirituous liquors, and were, during the
 “ whole of the intermediate time, exposed
 “ to wet and cold, and all the rigors of the
 “ climate ; circumstances, that would soon
 “ have accelerated the breaking out of the
 “ distemper, and rendered it so virulent, that

* See *Hawkeſworth’s Voyages*, Vol. II. p. 233.

† *Bougainville’s Voyage*, Eng. Translation. p. 274 and 286.

‡ *Hawkeſworth*. Vol. I. p. 489, 490.

“ they

“ they must have had recourse to the affis-
 “ tance of the surgeon : yet, when we went
 “ out of Q. Charlotte’s sound, six months
 “ after leaving the Cape, a midshipman on
 “ board the Adventure discovered that he
 “ had been infected by one of the New Zea-
 “ land females. In O-Taheitee, and the So-
 “ ciety-Isles, we found in 1773, the females
 “ communicated this disease to several of
 “ our people, From the Friendly-Isles no
 “ infection was either received or commu-
 “ nicated, because the people who laboured
 “ under it were not allowed to have any
 “ commerce with the females of those isles.
 “ The crew left the Marquesas and Easter
 “ Island without catching or communi-
 “ cating the evil, because not a single person
 “ was infected with it, either before we
 “ visited those parts, or for some time after
 “ we had left them. At Taheitee and the
 “ Society-Isles, the infection came in 1774
 “ again into our ship ; and as we staid only
 “ a few days at Namocka, I believe none
 “ either received or communicated it there.
 “ In the more western isles of Mallicollo,
 “ Tanna, and New-Caledonia our sailors had
 “ no connection with the females ; but in
 “ New-Zealand the disorder was again com-
 “ municated to our crew.” Dr Forster’s

T

conclusion

conclusion of this state of facts deserves particular attention and examination : “ So that
 “ there is great reason to believe, that the
 “ Venereal Disease has not been lately intro-
 “ duced into these isles, but was known
 “ there for a long time ; especially as Ohe-
 “ deeddee or Mahaine, the young man of
 “ Borabora, who went with us in 1773 from
 “ O-Raiedea, told us, that this evil was very
 “ common in Borabora, where however, no
 “ European ship had ever touched ; nay he
 “ informed us, that his own mother died of
 “ this disease before the arrival of the Euro-
 “ peans in these isles.” He is therefore in-
 clined to believe that the disease was not
 imported into, but originated in, these islands
 from libidinous excesses, and particularly
 from the promiscuous and unrestrained in-
 tercourse of persons afflicted with the le-
 prosy in its various stages. Having advanced
 thus far, he ventures one step farther, and
 endeavours to shew, that the disorder in
 question was not introduced into Europe by
 the sailors of Columbus returning from the
 discovery of America ; and that it did not
 even, as we generally suppose, make its first
 appearance in Europe about the period of
 that important event, but was long before
 distinctly marked and familiarly known. To
 establish this doctrine he has no other re-
 source

source than the revival of that old opinion, (which has been already mentioned as far as it relates to the South Sea islands) that this disease may be generated in hot climates by libidinous excesses, especially amongst people, particularly liable to cutaneous, herpetic, and leprous affections. The arguments, which he adduces, have little novelty, but they are too curious to be overlooked: I shall therefore first produce them, and then venture a few remarks, first upon the general doctrine, and then as it more particularly applies to the state of the new-discovered islands.

* “ That the Venereal Disease is by no means to be considered, as an evil imported into Europe from America, has been sufficiently proved, he says, by M. Sanchez, a very able and learned physician, (who has been for some time in Russia. †) It appears from his enquiries, that the Venereal Disease appeared so early as in March, 1493, in Italy, and in Auvergne in France; at the very time when Christopher Columbus returned to Spain from America; for he landed at Seville,

* *Foster's Observations, &c.* p. 492. Note.

† *Dissertation sur l'origine de la Maladie Venerienne, Paris, 1752, 12°. Examen Historique sur l'apparition de la Maladie Venerienne en Europe, Lisbonne, (Paris) 1774.*

“ on the 15th of March, 1493,† and in the
 “ middle of April of the same year he ar-
 “ rived at court, which then resided at Bar-
 “ celona. From a book of Peter Pintor, a
 “ Spanish physician, it appears that the Ve-
 “ nereal Disease raged at Rome in March,
 “ 1493; and it is likewise to be collected
 “ from other writers, that about that time
 “ this evil spread all over Italy in the form
 “ of an epidemical distemper. Pacificus
 “ Maximus, a poet, whose book was printed
 “ at Florence, 1489, describes, Lib. III. ad
 “ priapum, the Venereal Disease in such a
 “ manner, that no doubt can be entertained
 “ of its being known at that period of time.
 “ In the church of St Maria del Popolo at
 “ Rome, is a sepulchral monument, erected
 “ to the memory of Mario Alberti, *qui an-*
 “ *num agens 30 peste inguinaris interiit, anno*
 “ 1485, about eight years before Christopher
 “ Columbus returned from his first voyage.*
 “ The Jews, who were expelled from Spain,
 “ brought the disease into Africa, according
 “ to *Leo Africanus*. † And it was there for

† The earliest date of the arrival of Columbus in Europe is, Feb. 24. 1493, when he entered the Tagus. See *Robertson's America* 8°. Vol. I. p. 153.

* See *Viaggiana*, or detached remarks on the buildings, pictures, statues, inscriptions, &c. &c. in ancient and modern Rome, *London*, 1776.

† *Descriptio Africae*, Lib. I. p. 86. edit. Elzevir *Lugdun. Bat.* 1632. 16^{mo}.

“ that

“ that reason called *Malum Hispanicum*, the
 “ Spanish evil. But Mariana,* says ex-
 “ pressly, that the order, for the expulsion
 “ of the Jews from Spain, was given in
 “ March 1492, and only four months were
 “ allowed them, so that they were probably
 “ gone in June 1492, before Christopher
 “ Columbus sailed for the discovery of Ame-
 “ rica. Nor are there testimonies wanting
 “ that in times still more remote, symptoms
 “ of the Venereal Disease were well known:
 “ Alfonsus I. King of Naples, died 1458,
 “ of the gonorrhoea, or as Tristano Carac-
 “ ciolo *de Varietate fortunæ*, expresses it,
 “ *morbo insuper immundo et pertinaci, involun-*
 “ *tario scilicet insensibilique spermatis fluxu.*
 “ Ladislas King of Naples likewise died
 “ 1414, of an infection in his genitals, com-
 “ municated to him by a girl, whom he
 “ kept. † More instances, that the Venereal
 “ Disease had been known amongst the an-
 “ cients, are to be found in Platner’s *Opus-*
 “ *cula*. ‡ Petrus Martyr de Angleria men-
 “ tions, § that Ario Barbosa, Professor at

* Lib. XXXIV. Cap. I. ad annum, 1492.

† *L’Art de verifier les dates*, p. 903. Cardami’s Chronicle from 1410, to 1494.

‡ *Joh. Zach. Platneri Opusc.* Tom. II. Prolus. III. *De Morbo Campano.* p. 21. Lipsiæ, 1748. 4°.

§ Lib. I. Epist. 67, dated April 5. 1489.

“ Sala-

“ Salamanca, was severely afflicted with the
 “ *Bubas* or French disease. Lastly in Mura-
 “ tori’s Collection, * it appears from the
 “ Chronicon Placentinum, that in the year
 “ 555, after Christ, there was an epidemical
 “ pestilential distemper in Italy, which among
 “ other symptoms had these peculiar ones,
 “ that the glands began to swell to the size
 “ of a nut, particularly at the parts, which
 “ modesty bids conceal, which swelling was
 “ followed by an intolerable heat, and that
 “ those afflicted with that dreadful evil died
 “ in a day or two. All these arguments
 “ encourage me to suppose, that the Vene-
 “ real Disease was not uncommon in ancient
 “ times; that it however broke out with
 “ new rage about the year 1493, and that
 “ fixing and attaching itself upon many
 “ other epidemical distempers, it became
 “ virulent, by being communicated by coha-
 “ biting with women. We need not wonder
 “ therefore, that the disease should have
 “ made its appearance at Taheitee and its
 “ neighbourhood, long before the arrival of
 “ Europeans at their isle.”

In my observations upon this passage, I
 shall first make a few remarks relative to the

* *Muratori Collectio Scriptorum Historiæ Ital.* Tom.
 XVI. p. 554, 555.

subject in general, and then more particularly as it is connected with the medical history of the South Sea islands, not intending at present to go any farther than the bounds which a slight commentary will fairly admit.

To confute the whole of Dr Forster's arguments is impossible ; because they can only be confuted by denying the veracity of his evidence, which perhaps can be done only by counter proofs more strong and cogent. The most indisputable however and the best established of the facts adduced by him go no farther, than to suggest a doubt, whether the disease was originally imported from America by the sailors of Columbus, but certainly do not prove, that it was not at that period a new disease, which made its appearance first about the year 1493, and was totally unknown to the ancients. It is observable, that the most authentic and creditable of these authorities being the date within the very small compass of five or six years from 1488 to 1494. If the remainder of his histories were given by medical persons, or by persons from their education and profession qualified to speak decisively on such a subject, more stress might be laid upon them : but they have been so satisfactorily confuted in the introductory Chapters of Astruc's

Astruc's work, that they deserve but little attention : a few however of the most remarkable facts alledged shall be presently more particularly examined. As the disorder, within so short a time, (a few months in the beginning of the year 1493,) appeared in different quarters of Europe, at the most remote distance from each other, it has been argued, that it cannot be conceived that it originated in any one place, from whence it was spread by contagion from contact. The rapidity of its dissemination indeed, or rather the universality of its prevalence at one and the same time, was considered by many contemporary writers, as altogether miraculous ; and they imagined, that even the air was impregnated with noxious particles, which, received into the human body, became the *semina morbi* of this new and unparalleled affection. Thus Fracastorius, rejecting the opinion of the slow mode of its communication by the actual intercourse of diseased persons, says, *

At verò, si ritè fidem observata merentur,
Non ita censendum : nec certè credere par est
Essè peregrinam nobis, transque æquora vectam
Contagem : quoniam imprimis ostendere multos

* *Siphylis*, Lib. I. V. 54.

Possumus, attactu qui nullius hanc tamen ipsam
 Sponte sua sensere lueni, primique tulere.
 Præterea et tantum terrarum tempore parvo
 Contages non una simul potuisset obire.
 Aspice per Latii populos, quique herbida Sagrae
 Pascua, et Ausonios saltus, et Iapygis orae
 Arva colunt : spectata Tiberis quâ labitur, et quâ
 Eridanus centum fluviis comitatus in æquor,
 Centum urbes rigat, et placidis interfluit undis.
 Uno, nonne vides, ut tempore pestis in omnes
 Sæviit ? ut sortem pariter transegimus unam ?
 Quinetiam externos eadem per tempora primum
 Excepisse ferunt : nec eam cognovit Ibera
 Gens prius, ignotum quæ scindere puppibus æquor
 Ausa fuit ; quam quos disternat alta Pyrene,
 Atque freta, atque Alpes cingunt, Rhenusque bi-
 cornis ;
 Quam reliqui, quos lata tenet gelida ora sub arcto.
 Tempore non alio, Pœni, sensistis, et omnes,
 Qui lætam Ægyptum metitis, fœcundaque Nilo
 Arva ; et palmiferæ sylvas tondetis Idumes.
Quæ quum sic habeant sese, nempe altius isti
Principium labi, rerumque latentior ordo,
(Ni fallor) graviorque subest, et major origo.

All the traditions, collected by Dr Forster,
 and intended to shew that this disorder ex-
 isted before the period abovementioned, and
 particularly that it was known to the an-
 cients, are extremely equivocal, and, as I have

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already

already insinuated, are most completely answered and explained in the introductory chapters of Astruc's work. It is indeed perfectly incredible, that a disease so dreadfully infectious, so distinctly characterized, and so peculiarly connected with some of the principal operations of human life, should have escaped the notice not only of the ancient poets and historians, but of those justly admired medical writers, whose remaining works evince a degree of attention, sagacity, and accuracy in the investigation and description of the diagnostic symptoms of disorders, attained by few modern physicians, except perhaps Sydenham and Boerhaave, with all the aids of an improved knowledge of nature, and a more perfect acquaintance with the laws of philosophy and physiology.

It may be observed too, that most of the cases, adduced from more modern writers to the same purpose, are taken from the obscure works of persons, probably very little qualified to give an opinion concerning the diagnosis of a disease. A few observations on some of those, mentioned by Dr Forster, will illustrate this.

Little reliance can be had on the inscription to the memory of Mario Alberti, *qui*
annum

annum agens tricesimum peste inguinaris interiiit, in the year 1485;* as there were,

* Mr. Swinburne, in his account of the siege of Naples, and of the astonishment which prevailed amongst the Neapolitans on the failure of their usual miracle, the liquefaction of the blood of St Januarius, has some observations relative to this very inscription, which strongly confirm my opinion concerning the disorder it alludes to, and also strengthen the supposition, that the Venereal Disease was unknown before the period of that celebrated siege and the return of Columbus from America. That this disease was imported from the East is still less probable, than that it was introduced from America: perhaps we must be obliged, with Fracastorius, to admit,

————— “altius isti

Principium labi, rerumque latentior ordo,
(Ni fallor) graviorque subest, et major origo.”

“Were it becoming a reasonable man to adopt the Neapolitan idea of St Januarius’s blood being endowed with the gift of prophecy, one might suppose, that its obstinate induration had not in view the mere event of the siege, but rather pointed to a cruel disease, which made its first appearance in our hemisphere at that period and in that camp. It is said, that this tremendous scourge of debauchery was first imported by the companions of Christopher Columbus from the Charibbee islands, where it was an aboriginal malady; and that women infected by them were designedly sent out of Naples to spread contagion amongst the French, by whom the infernal poison was communicated to the rest of Europe. But authors differ in their opinions concerning the introduction of this disorder: some incline to give it an Eastern or Egyptian, not an American origin, and ground their notion upon the inscription of a tomb in the church of S. Maria del Popolo at Rome.” (Mr Swinburne’s copy of this inscription differs a little from that of Dr Forster, and is probably more correct. *Marco Antonii equitis Romani filio ex Albertonum familia, corpore animoque insigni, qui annum agens XXX. peste inguinaris interiiit an. salutis Christianæ M CCCC LXXXV. die XXII. Julii hæredes B. M. P.*)

no doubt, both before and after the appearance of the Venereal Disorder, many other complaints, which attacked the organs of generation in consequence of those libidinous excesses, in which the antient world indulged with equal if not greater freedom than the modern, as the writings of Suetonius, Tacitus, and Juvenal most amply testify. And affections of those parts from other causes do even in these more enlightened days, when every symptom of the disorder is so accurately known, often deceive the most experienced practitioners. How frequently has the nature of this complaint, when every art of concealment has been used, been at last detected only by the success of a particular medicine, empirically administered? Besides it may be added (which

“ The difficulty lies, he adds, in proving this pestis inguinaria to be really the disease in question, and not a plague, that had its ulcer in the groin, as others have theirs under the arm, in the side, or elsewhere; for it is an observation made by many medical practitioners in the Levant, that each plague throws out its mortal tumour in one particular part of the body upon all patients. If this sentiment of the lues coming from the East were incontrovertible, it would follow, that to all the accumulated horrors of tyranny, rapine, and murder, exercised by the Europeans upon the innocent Americans, we might add the introduction of a fatal and loathsome disease, which completed the desolation of that continent, by destroying the few wretches their sword had spared.”

Swinburne's Travels in the two Sicilies, p. 93.

at

at the same time shews, that the epidemical pestilence recorded in the *Chronicon Placentinum* can by no means be considered as a Venereal Complaint*), that swellings of the

* Several of the English Chronologists and Chroniclers assert, that the plague raged in this Kingdom with dreadful violence in 1477 and 1499. Before I draw any inference from this observation, I will take the liberty of transcribing a passage from Dr *Mead*. † “The *Sweating Sickness* before hinted at, called *Sudor Anglicus* and *Febris Ephemera Britannica*, because it was commonly thought to have taken its rise here, was most probably of a foreign original: and though not the common *Plague* with *Glandular Tumors* and *Carbuncles*, yet a real pestilence from the same cause, only altered in its appearance, and abated in its violence, by the salutary influence of our climate. For it preserved an agreement with the common *Plague* in many of its symptoms, as excessive faintings and inquietudes, inward burnings, &c. &c. these symptoms being no where observed in so intense a degree, as here they are described to have been, except in the true *Plague*: and, what is much more, it was likewise a contagious disease.

The first time this was felt here, which was in the year 1485, it began in the army, with which King *Henry VII.* came from *France* and landed in *Wales* ‡: and it has been supposed by some to have been brought from the famous siege of *Rhodes* by the *Turks* three or four years before, as may be collected from what Dr *Keyes* says in one place of his treatise on this disease.” §

The learned author's further observations on the distinguishing symptoms of this disorder prove it to have been of the *pestilential type*; and the particular æra of its appearance, concurring with the above-recited proofs, that the true *Plague* did appear in this kingdom very nearly at the same time, may reasonably induce us to conclude, that

† *Mead* on the Plague, p. 72. edit. 9. 8°.

‡ Vid. Caium de Eph. Febre Britan. and Lord *Bacon's History of Henry VII*

§ Page 162. edit. Lovan.

glands in the axilla and inguen, and even of the testicle itself, are not uncommon attendants of a great variety of epidemic fevers, and diseases communicated by contagion, though not of a siphylitic nature. Of these Dr Fordyce * enumerates some instances in his Review of the Venereal Disorder; and Dr Layard † in his Essay on the bite of the mad dog. It may be added, that of those fevers which are commonly called pestilential, especially the true plague, glandular tumors in the axilla and inguen, particularly the latter, are esteemed the diagnostic symptom. ‡ The intolerable heat attending, and

the kingdoms on the continent were more or less afflicted in the same manner, though it may not be easy to produce a positive proof of it, the attention of their historians being occupied in tracing the important revolutions, which then took place, or the calamities of war, which desolated the earth, and more particularly the fertile provinces of Italy. Hence it may be reasonably concluded, that the *Pestis Inguinaria* in the text was more nearly allied to these pestilential disorders, than to the subject of our present disquisition.

* Fordyce's Review of the Venereal Disorder, Sect. 7.

† Layard on the Bite of the Mad Dog, p. 44.

‡ Mead on the Plague, p. 5. et seq.

Cullen's Nosolog. G. XXVII. Pestis.

Sauvages, Nosolog. Cl. III. Ord. I. G. I. Pestis. He expressly says, "Et ut character variolæ ex pustulis, ita Pestis character juxta omnes fere neotericos ex bubonibus deducendus est," and below, "Bubones sunt glandulæ duræ, tumidæ, dolentes, ad suppurationem tarde vergentes, sæpius in inguinibus, quandoque in cruris angulo, in axillâ, maxillâ, jugulo, pone aurem enati, unde evidens est parotidem a bubone non nisi situ discrepare."

the

the rapid fatality consequent upon, these swellings, in the pestilence alluded to by Dr Forster, almost demonstrably prove the complaint not to have been Venereal : for in the latter the inguinal swellings are seldom very rapid in their progress, in some cases are indolent for many days ; and as rarely is the disorder suddenly fatal. *

That Alfonso, King of Naples, died of a Venereal Gonorrhoea in the year 1485, is an assertion without any plausible foundation of truth. A circumstance of this nature, rendered notorious by the high rank of the victim, must have been so well known, that those authors, who have treated of this Venereal symptom, could not have presumed to assert, that it did not make its appearance 'till the more common symptoms of the Lues had been well known for more than twenty years ; nay, till the virulence, with which they had made their first invasion, was considerably mitigated and corrected. † Carra-

* See *Astruc*, De Morb. Ven. Lib. III. Cap. V. Sect. 1. De Definitione, Descriptione, et Differentiis Bubonum Venereorum. *Van Swieten*, Comment. in Boerhaavii Aphorisma, 1448.

† *Astruc*, De Morb. Ven. Lib. I. Ch. XII. Sect. 4. et, Lib. V. De Scriptoribus Sæculi XVI, de Jacobo a Bethencourt. *Van Swieten*, Comment. in Boerhaavii Aphor. 1447.

ciolo only says, that Alfonsus was destroyed *Morbo immundo, involuntario scilicet et insensibili spermatis fluxu*. But this proves no more, than that his disorder was a seminal weakness, a species of the *Tabes Dorsalis* or *Gonorrhoea* *Ονειπογυνος*. † The Venereal *Gonorrhoea* is neither *Spermatis fluxus*, nor is it a discharge without pain, *insensibilis*.

Even this account of the cause and manner of this Prince's death is after all very weakly founded. It must be owned, that no one, who plunges into libidinous luxury is exempt from its debilitating effects, which generally lay the foundation of corporeal and mental imbecility, and very often cut short the thread of life: whereas Alfonsus lived to a considerable age, passed no small part of his life in the active engagements of the camp and the field, and in his declining years governed his united dominions of Arragon, Sicily, and Naples with such prudence and prosperity, as to have attained from historians the title of great. Nor do they in general make any mention, that he was subject to any natural or acquired infirmity of body or mind. *

† *Sauvages*, Nosolog. Cl. IX. Ord. III. Gen. XXX. Sp. 3. et Cl. X. Ord. I. G. I. Sp. 1.

* *Swinburne's Travels through the two Sicilies*, p. 22.
That

That Ladislas, King of Naples, died of a Venereal Disorder is not less disputable, than the former assertion. In the account given of him in the *Dictionnaire Historique Portatif*, it is said, “ Il mourut a Naples le
 “ 16 Août 1414, à 38 ans, d’un poison, que
 “ la fille d’un medecin lui avoit donné a
 “ Perouse,” a mode of expression extremely inaccurate, and not to be hazarded by a biographer, if he really died of the Venereal Disorder. Had that been the case, the writer would have been either more or less explicit, than he is. If he was willing to conceal the misfortune or the disgrace of the king, he was not required to say so much : if that prince really died of this disorder, and the author was desirous of perpetuating the memory of that event, he would not have expressed himself in terms so ambiguous.

But the history of Ladislas supports the author’s hypothesis with more plausibility than that of Alfonsus ; because historians agree, that the Ladislas delivered from enemies at home, and an overmatch for those abroad, gave himself up to pleasure, and shortened his days by excess of debauchery. It is most probable however, that the prejudicial consequences of these excesses led him to have recourse to medicine, and to entrust himself

to the care of every empiric, who was base enough to flatter him with the perfect restoration of his debilitated frame ; and that to one or more of the pretended restoratives, thus administered by the hand of empiricism, he finally became a victim.

Having premised these few observations, I shall now return more particularly to the account of the disorder in the South Sea islands. I have already mentioned, that Dr Forster insinuates, not indirectly, that the Venereal Disorder was known at Otaheite, &c, before any European ships ever touched at those islands. But Capt. Cook in his account of the same voyage speaks a very different different language. “ They call the Venereal Disease *Apa-no-Pretane* (English Disease), “ though they say to a man, that it was “ brought to the island by Bougainville ; but “ they thought he also came from *Pretane*, “ as well as every other ship, which has “ touched on the island. Were it not for “ this assertion of the natives, and none of “ Capt. Wallis’s people being affected with “ the Venereal Disease, either while they “ were at Otaheite, or after they left it, “ I should have concluded, that long before “ these islanders were visited by Europeans, “ this, or some disease which is near a-kin “ to

“ to it, had existed among them. For I
 “ have heard them speak of people dying of
 “ a disorder, which we interpreted to be
 “ the pox, before that period. These people
 “ are, and were before Europeans visited
 “ them, very subject to scrophulous disor-
 “ ders, so that a sea-faring man might
 “ easily mistake one disorder for another.” *

As the inhabitants of these islands had no name for this disease before the arrival of the European ships, which may be fairly inferred from their calling it afterwards *Apā-no-Pretane, the British Disease*, is it not very improbable, that the disorder existed at all amongst them before that period? This name seems to have been given by the natives to this disease during the interval between the first and second voyages of Capt. Cook; for it appears very plainly by Hawkesworth's account, † that they had no name at all for it at the time of the first voyage, and distinguished it only by a metaphorical expression of the same import as rottenness, but of a more extensive signification. They described, in the most pathetic terms, the sufferings which the *first* victims to its rage endured.

* Capt. Cook's Account of the Voyage of the Resolution and Adventure, &c. &c. Vol. I. Ch. XIV. p. 181.

† See Hawkesworth's Voyages, Vol. II. p. 233.

It spread, they said, an universal terror and consternation among the inhabitants, so that the sick were abandoned by their nearest relations, lest the calamity should become universal by contagion, and were left to perish alone in such misery, *as till then had never been known among them.*

Do not these accounts, especially those expressions, which are distinguished by italic characters, sufficiently shew, that the disease was not indigenous in these islands, but communicated to them by the intercourse of strangers, whose visit and its effects were fresh in the memory of the persons then living? Are not we therefore justified in adopting the following conclusion, suggested by an industrious and well instructed, though anonymous, writer on these subjects? “ If
 “ an European ship (be it Mr de Bougain-
 “ ville’s or the Dolphin, Capt. Wallis’s, in
 “ some measure contributing) did commu-
 “ cate this baneful disease to a healthy race
 “ of people, and this not to one island only,
 “ but spreading it among several, it is a con-
 “ sequence incidentally arising from Euro-
 “ pean curiosity and thirst after knowledge,
 “ which cannot be too-much regretted; and
 “ will entail a misery upon these Indians,
 “ so dreadful, that all the attempts to enrich
 “ them

“ them with new species of vegetables and
 “ animals cannot in any degree compensate
 “ for, even if such endeavours had proved
 “ as effectual, as they were well intended.”*

Upon the whole state of this argument, I am induced to believe, that Dr Forster desirous of freeing his European brethren from the ignominy of having introduced this calamity into the South Sea islands, collected every argument which ingenuity could suggest to persuade himself and others : he hoped particularly to secure this point, if by reviving the old and almost obsolete doctrines he could in any degree shew, that the disease may be generated in a hot climate by the promiscuous and excessive intercourse of persons afflicted with leprous and other cutaneous affections; and could prove that it was neither introduced into Europe by the sailors of Columbus in 1493, nor entailed at that period by a peculiar exertion of the divine vengeance against the multiplied crimes of the human race, but existed long before: for then, it might be inferred, that the same causes would produce the same effects in these islands, and that neither modern times

* *New Discoveries* concerning the World and its inhabitants, &c. &c. London, 1778. 8°. Johnson, Page 62.
 nor

nor modern travellers deserve the accusation of introducing it there.

I must acknowledge, that his arguments have not brought conviction to my mind; though I have not the presumption to suppose, that the observations, which I have myself made, will be thought sufficient to satisfy those, who may have adopted his opinion. As different sentiments on subjects of science must unavoidably subsist amongst men, to whom the truth can be only revealed by slow and gradual inquiries; it is by a candid and dispassionate examination only, that we can hope to attain this grand object of all literary pursuits: and he who has laboured to promote that great cause, even though his assistance may not be sensibly felt, may at least indulge himself with the reflection, that in endeavouring to be useful, he has not totally misemployed his time.

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M DCC LXXX II.

N.B. THE former Syllabus was unavoidably very concise and general. It was however as full, as with due Allowance to the Labour and Difficulties attending a recent Appointment in such a Line, could perhaps be expected. The University during the last Course gave demonstrative Proofs of their sincere Zeal to raise a School of Medicine in this Place, by their Indulgence in Regard to the Degrees, and their liberal Assistance in the Improvement of the Laboratory. — To keep Pace with them in the Promotion of this laudable Design the Lecturer has thought it incumbent on him to draw up a more explicit View of his Attempts to fulfil their Expectations in the Department committed to his Charge. — The following Sheets are yet but imperfectly prepared to meet the Public Eye. — They are principally intended for the Use of the Class, with whom the Lecturer may have Opportunities of removing the Difficulties and correcting the Errata. For the greater Perspicuity, technical and foreign Expressions have been studiously avoided, and English Terms, as much as possible, adopted.

A
S Y L L A B U S
O F
D R. W A L L 's
Lectures in C H E M I S T R Y.

Read in the Museum, OXFORD;

February, 1782.

L E C T U R E I.

INTRODUCTION. OF the Extent of the Science of Chemistry. Definition. Defects of the most celebrated Definitions. Distinction between Chemistry and Natural Philosophy. The Utility of Chemistry; it's Connexion with various Arts and with Medicine. The History of Chemistry; ill-founded Opinions concerning it's Antiquity. Of the *Alchemists*; Origin and History of this extraordinary Sect. Of the enthusiastic Principles of the *Arabians*. The Transmutation of Metals. Of the most enlightened of the Alchemists;
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mists ; *Roger Bacon*. History of the Invention of Gunpowder. The universal Medicine ; *Raymond Lully* ; *Basil Valentine* ; *Paracelsus* ; his Character more largely described. Of the Application of Mercury in the Cure of the Venereal Disease. Consequences resulting from that Discovery. Of the Alcahest or Universal Solvent ; *Van Helmont*. Circumstances, which encouraged the Study of Chemistry in the 14th and 15th Centuries, &c. It's Progress 'till the Time of Lord *Bacon*. Societies formed for the Cultivation of Natural Knowledge by Experiments. The Priority of those at *Paris* and *London*. Eminent Persons, who have since promoted the Study of Chemistry ; Sir *I. Newton* ; Mr. *Boyle*. Causes which retarded the Progress of this Science in England. More successfully cultivated in Germany, by *Stahl*, *Hoffmann*, and *Boerhaave*. A short Account of their chemical Works. Dr. *Hales*'s Merit in recalling the Attention of Philosophers in England to this Study. Other Causes which have concurred to this Effect. Present State of the Science.

L E C T U R E II.

Of the best Mode of delivering Lectures in Chemistry. The Method, which will be adopted in this Course. Division of the Course according to the Definition into two general Heads. I. The General Doctrines of *Heat* or *Fire*, and of *Mixture*. II. The particular Effects of the Sub-Divisions comprehended under the 1st General Head ; α . The general Effects of *Heat* and the modes of exciting it ; β . The general Effects of *Mixture* ; and γ , as connected with both, a Description of the *chemical Apparatus*. Sub-Divisions comprehended under

under the 2nd general Head. The Objects of Chemistry arranged under six Classes: α , *Saline*; β , *Earthy*; γ , *Inflammable*; δ , *Metallic*; ϵ , *Aerial*; and ζ *Aqueous Substances*. To which will be added an Explanation of the Doctrine and Tables of Elective Attraction or Affinity; and a general Account of Animal and Vegetable Bodies. I. Of *Heat* or *Fire*. Obscurity of the Doctrines relative to it's Cause. It's Effects considered: 1. *Expansion*; 2. *Fluidity*; 3. *Evaporation*; 4. *Ignition*; 5. *Inflammation*. I. Of EXPANSION. Of the Communication of Heat. The Expansion of Bodies shewn by Experiments. Useful Inferences from these Experiments. Of *Pyrometers*. Modes of correcting the Irregularity of Time Pieces as depending upon the Expansion or Contraction of Metals. *Graham's* and *Harrison's* Pendulums. Exceptions to this Law of Expansion. Of the Expansion of freezing Water. Experiments of *Boyle* and the *Florentine Academy* on this Subject. Some natural Effects dependant on the Expansion of Ice enumerated. Hypotheses concerning Ice. Of the Invention of *Thermometers*. The Air Thermometer. The Spirit-Thermometer of *Boyle* and the *Florentine Academy*. *Newton's* Oil Thermometer. *Fahrenheit's* Mercurial Thermometer. An Attempt to explain their Construction and Graduation, and to adjust them to each other. Of the fixt Points of Thermometers. The Use and Application of these Instruments.

L E C T U R E III.

The Laws of the Communication of Heat farther considered. Dense and compact Bodies sooner heated and cooled than those of a rarer Texture.

Illustration of this Position from some common Phænomena of Nature. Exceptions to this Law in the Case of Fluids. Illustrated by the Effect of Heat on the Air. Many Phænomena explained from these Principles. Of the Circulation produced in Fluids by Heat. Of the Causes of COLD. Theory of *Frost*. An Account of the greatest Degrees of natural and artificial Cold, which have been noticed. Of the Congelation of *Mercury*. 2. Of FLUIDITY. Proofs that it is in all Cases an Effect of Heat or Fire. The old Opinion of the spherical Particles of Fluids ill-founded. The Consolidation of Fluids and the Freezing of Water not to be ascribed to the Introduction of agglutinating or cementing Particles. The Degree of Heat necessary to the Fluidity of Bodies. It's Mode of Action. Changes which solid Bodies undergo, when rendered fluid by Heat and again suffered to congeal. *Vitrescence*. Fluidity not solely dependant on sensible Heat. Dr. *Black's* Theory of *Latent Heat* explained.

LECTURE IV.

3. EVAPORATION. Definition of Vapour or Steam. The Extent of this Effect of Heat. The Expansibility and Force of the Steam of Water. Various Applications of this Property in the mechanic Arts. Description of the *Fire Engine*. Of the vaporific Point of Bodies. The Effect of mechanical Pressure in retarding Evaporation. Of *Papin's Digester*, and the Principles on which it operates. The Process of Evaporation in Water described. Probability that Heat is absorbed in the Process. Dr. *Black's* Experiments. Of the Promotion of Evaporation by the Diminution of Pressure. Dr. *Cullen's Experiments* related. The Processes

of Evaporation, Sublimation, and Distillation compared and distinguished. Are not all Bodies volatilizable by some Degree of Heat? The Difference between Vapour and Steam farther investigated. Of spontaneous Evaporation and it's Phænomena. Of *the Ascent of Vapours* and the Theories concerning it; *Nieuwentyt's*; *Halley's*; *Desaguliers's*. The later Opinion that Vapours are suspended in the Air by Solution. The solvent Power of the Air illustrated. Comparison between the Phænomena of Solution and spontaneous Evaporation. The Production of Rain, Dew, Mist, Hoar Frost, explained. Arguments against this Theory. Possible Fallacy in such Arguments. Application of these Observations to some Phænomena of Animal Bodies.

L E C T U R E V.

4. OF IGNITION. Reasons for touching lightly on this Subject.

5. OF INFLAMMATION. Substances liable to it, thence called *inflammable*. Distinction between this and other Classes of Bodies. The Changes produced by Inflammation. Of the Residuum after Inflammation. Of the Principle on which Inflammability depends. It's Separation. It's Identity in all Instances. *Stahl's Theory*. Names of this Principle. *Phlogiston*; *Phlogistique*; *Soufre Principe*; *Principle of Inflammability*. Proofs of the Existence of this Principle. It's near Relation to elementary Fire and Light. Of the Effects of it's Combination with Bodies. The Necessity of Air to Inflammation shewn. Of the Means of exciting Heat: *α. By Friction or Percussion. β. By Mixture. γ. By Fermentation. δ. By Electricity. ε. By the Vis Vitæ in Animal Bodies. ζ. By the Solar Rays. η. By the Inflammation of Fuel.*

α. By *Friction* or *Percussion*. The ill Consequences of Inattention to this Cause in the Construction of large Machines.

β. By *Mixture*. Mixtures which excite Heat. Acids with Alkalies. Acids with Oils. Acids with Animal and Vegetable Substances. Acids with Rectified Spirit of Wine. Acids with Metals. Acids with some Earths and earthy Salts. Acids with Water. Q. Lime with Water. Alkalies with Oils. Water with deliquescent Salts. Some Experiments to illustrate this. Of Mixtures which generate Cold. Solution of Salts in Water. Combination of crystallized Salts with Ice or Snow. Rectified Spirit of Wine with Ice.

γ. By *Fermentation*. Of the Degree of Heat produced in the several Stages of Fermentation. Application of this Heat to the Purposes of Agriculture, &c.

δ. By *Electricity*. The Analogy between the Electrical Fire and Lightning. Peculiarities of it's Operation.

ε. By *the Vis Vitæ in Animal Bodies*. Of Animal Heat. Heat spontaneously generated no absolute Criterion of Animality. Of the Power which Vegetables possess of generating Heat. Equality of the Heat in Animals. *Theories of Animal Heat*. Vain Attempts to explain this Process by mechanical or common chemical Principles. Of the Connexion of animal Heat with the State of the Respiration and Circulation. Of the Generation of Heat by the Extrication of the Principle of Inflammability. Proofs of the Extrication of this Principle from the Blood in the Course of the Circulation.

ζ. By *the Solar Rays*. Conjectures concerning the Matter of Solar Light and Heat. Some peculiar Effects

Effects of the Solar Heat mentioned. Of the Invention, Properties, and Application of Specula and Lenses. Of the Absorption of the Rays of Light by dark Surfaces, and their Reflection by such as are white and shining. Experiments of Mess. Boyle, Macquer, and Beaumè instanced. The Futility of the celebrated Story of *Archimedes*' Mirror. Mr. Buffon's Contrivance to fire Wood at 200 feet Distance. The Lenses of *Villette* and *Tschernhaus*.

n. By the Inflammation of Fuel. Of the various Kinds of Fuel used in chemical Operations. a. *Inflammable Fluids*. b. *Peat*. c. *Charcoal of Wood*. d. *Charcoal of Pit-Coal*. e. *Wood*. f. *Pit-Coal*.

a. Of *Inflammable Fluids*. *Spirit of Wine* and *Oils* (considered as Fuel) their Application, Advantages and Defects.

b. Of *Peat*. It's Production and Use.

c. Of *Charcoal of Wood*. It's Preparation, it's Advantages: it's Imperfections how removed.

d. Of *Pit Coal charred*. It's Defects. Of *Kilkenny Coal*. The Effect of the Fumes of Charcoal, and the Method of Cure in such Cases illustrated.

e. f. Of *Fossil Coal and Wood*. Objections to their Use in chemical Operations. Of the Nature of *Flame*, and the Action of Air upon it. Description and Use of the *Blowpipe*. Some general Observations on the beneficial Influence of Heat in the System of the Universe.

LECTURE VI.

OF the general Effects of MIXTURE. Experimental Illustration of the Phænomena which take Place in Mixtures. The Heat produced in some Instances,

Instances, and Cold in others, See LECT. V. The Attraction of certain Substances to Water. Definition of some common Terms : *Deliquescence*, *Effervescence*, *Solution*, *Diffusion* or *Mixture*, *Emulsion*. Of the Separation of combined Substances. General Doctrine of *chemical Attraction* or *Affinity*; *Precipitation*; *Elective Attraction*; illustrated by Experiments. Hypotheses advanced on this Subject. Imperfection of the mechanical Doctrine of the peculiar Forms of the elementary Particles of Bodies. The *Newtonian* Doctrine of Attraction and Repulsion applied. Objections of the *French* and *German* Chemists. Reasons for preferring the Term Attraction to those of Affinity or Impulse. The Difference between Chemical and Mechanical Attraction illustrated. Canons or Rules to be observed in Solution; illustrated by Experiments. The Effect of Heat in promoting Solution. Chemical Attraction in almost all Cases diminished by the Diminution of Heat. The Doctrine of elective Attraction farther considered. *Geoffroy's* Table introduced and vindicated. Experiments. *Double Elective Attraction*. Of the Bulk of Compound Bodies. Experiments of Dr. *Lewis* and *Monf. Reaumur* on this Subject.

LECTURE VII.

Of THE CHEMICAL APPARATUS. *Vessels*. *Furnaces*. Of the Materials used in the Construction of chemical Vessels. Properties required in them. The Advantages of Glass, and it's Imperfections. Of *Annealing*. Defects of unannealed Glass shewn by Experiment. Of the Use of Metals in forming chemical Vessels. Their Defects. Of Earthen Ware. It's Advantages in great Degrees of Heat.
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The great Merit of Mr. *Pott* of *Berlin* in his Enquiries on this Subject. Of Porcelain. Of Black Lead. Chemical Vessels considered as to their Use, either in Operations of *Fusion*, *Evaporation*, or *Solution*. 1st. In *Fusion*. Crucibles. Common or Hessian Crucibles. Black Lead or Austrian Crucibles: their Properties compared. 2nd. In *Evaporation*. Evaporation sub-divided into, *a. Simple Evaporation*. *β. Distillation*. *γ. Sublimation*. *δ. Cementation*. Vessels used in *simple Evaporation*. Rules for conducting Evaporation. *β. In Distillation*: Three Modes of Distillation. *a. Per Descensum*. *b. Per Ascensum*. *c. Ad Latus*. *a. Of Distillation per Descensum*, with a Representation of an Apparatus used in that Process. *b. Of Distillation per Ascensum*. Description and Representation of the *Common Still*: it's Parts and their Uses. The Cucurbit; the Alembic; the Refrigeratory; the Receiver; the Worm Tub. Glass Alembics. *c. Of Distillation ad Latus*. Retorts and Receivers of different Kinds shewn. Tubulated Retorts and Receivers &c. *γ. Of the Vessels used in Sublimation*; Matrasses; Bolt Heads; Florence Flasks. Observations on the Forms, which Substances sublimed assume in Condensation: Sublimates; Flowers. Of subliming Pots called *Aludels*. *δ. Of Cementation*. The Term explained, and the Vessels required in it. 3. Of the Vessels used in *Solution*. The Operation of *Cobobation*. Of the Vessel called a *Pelican*. Of *Filtration*. OF FURNACES. General Doctrine of their Construction and Operation. Of the Modes of admitting and regulating Air. Of *Registers*. A Scheme for making one extremely accurate. Account of some of the principal Furnaces. The *Furnace of Fusion* or *Wind Furnace* described and explained. Mr. *Pott*'s Furnace. Observations on it's elliptical

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Form.

Form. Of *Bellows*. The *Water Blast* or *Bellows* described. Of the *Æolipile*.

LECTURE VIII.

Description of Furnaces continued. *The Assay Furnace* exhibited and described. *Muffles* shewn, and their Use explained. The *Reverberatory Furnace* for Distillation. *Balnea* or *Baths*: *Balneum Maris* et *Mariæ*; *Balneum Arenæ* or Sand Heat; *Balneum Vaporarium*; *Capella Vacua*; Dr. *Lewis's* *Mercurial Bath*. Of the *Lamp Furnace* with Dr. *Lewis's* Improvements. The *Athanasian Furnace* exhibited and described. Of *Portable Furnaces*: *Vigani's*; *Shaw's*; *Lewis's*; *Ruel's*. Of *Lutes* and the Coating or Lorication of Vessels and Furnaces. Common *Lutes* and Fire *Lutes*.

LECTURE IX.

OF THE PARTICULAR EFFECTS OF HEAT AND MIXTURE. Attempts to divide and arrange the Objects of Chemistry. Conjectures concerning the *Elementary Principles* of Bodies. Of the *four Elements*; *Fire*, *Air*, *Earth*, and *Water*. The Convertibility of what we call the four Elements into each other. Experiments of *Boyle*, *Margraaff*, *Priestley*, *Scheele* &c. related. Defects of an Arrangement founded on the Doctrine of the four Elements. Of the obscure Elements of the Alchemists: *Salt*; *Sulphur*; *Mercury*. Of the Division of Nature into three *Kingdoms*; *Animal*, *Vegetable*, *Mineral*. Defects of this Division, shewn by the Observations of Mr. *Lock*, and Dr. *Watson*. An Attempt at a more simple and useful Division. Six Classes: I. *Saline Substances*. II. *Earthy*. III. *Inflammable*. IV. *Metallic*. V. *Aerial*. VI. *Aqueous*.
A. Of

I. OF SALINE SUBSTANCES. Limitation of the Term. Definition of Salts. The general Properties and Appearance of them. Their Fusibility, Volatility, Solubility. Of the Phænomena of their Solution. Of the Quantity of Salts soluble in a given Quantity of Water. Of the Increase of the solvent Power of Water by Heat. Common Salt an Exception to this Law. Dr. *Lucas's* Theory of the Solution of Salts. Objections to it. Sir *Isaac Newton's* Theory. Facts which confirm it. Of the Separation of Salts from Water. *Evaporation to Dryness*. *Crystallization*. Of the regular Forms of *Crystals*. Directions for obtaining them most perfect. Explanation of that Appearance called *the Vegetation of Salts*. How prevented. Of the Quantity of Air and Water contained in the Crystals of Salts. Phænomena dependant on this Quantity of Water. The *Watery Fusion*; *spontaneous Calcination*; and *Decrepitation* of Salts shewn. *Theory of the Crystallization of Salts*. The Form of the Crystals has no Resemblance to the primary Particles of the Salt. Conjectures concerning the Analogy between Crystallization, and the polar Attraction of the Magnet — Crystallization not peculiar to Saline Substances. Instances of it in various Parts of Nature enumerated.

LECTURE X.

Continuation of the General Doctrine of Salts. Water saturated with one Species will dissolve a considerable Portion of another. Mode of obtaining separately the different Salts dissolved in the same Water. Of the Different *Orders, Genera, and Species* of Salts. Sub-Division of the Class into *Simple and Compound*. ORDERS of Simple Salts: *Alkalies; Acids*. A Table of the GENERA and SPECIES of simple Salts.

CLASS I. SALTS.

Ord. I. ALKALI.

Gen. I. *Fixt Alkali.*

Gen. 2. *Volatile Alkali.*

Sp. α . Mineral or Fossil Alkali.
 β . Vegetable Alkali.

Ord. II. ACID.

Gen. I. *Mineral Acid.*

Sp. α . Vitriolic.
 β . Nitrous.
 γ . Marine.
 δ . Acid of Spar.

G. 2. *Vegetable Acid.*

Sp. α . Native Acid of Fruits.
 β . Acid of Fermentation.
 α . Vinegar.
 β . Tartar.

G. 3. *Animal Acid.*

Sp. α . Acid. of Phosphorus.
 β . Acid of Ants, &c.

G. 4. *Anomalous Acid.*

Sp. α . Acid of Amber.
 β . ——— Borax.
 γ . ——— Benzoin.

Of the Varieties of these Species —

A. Of ALKALIES *in general*. Tests of an Alkaline Quality explained and demonstrated. *α*. Of THE MINERAL ALKALI. It's Crystals, and the Changes they undergo by Exposure. Of it's Origin. Account of the *Natron* of the Ancients. Proofs that the Substance called *Nitre* and *Natron* amongst the Ægyptians and other Oriental Nations was a mineral Alkali. Mode of obtaining this Alkali from the Ashes of Sea Weeds. *Sea Wrack* or *Kelp*; *Bariglia*; *Soda*. This Alkali obtained from Common Salt. *Cronstedt's* Opinion of it's Origin from calcareous Earth examined. It's Use in the Composition of Soap, in dying, and in the Glass Works.

β. Of THE VEGETABLE FIXED ALKALI. It's distinguishing Properties. It's Attraction for Water and Disposition to deliquesce. It's Crystallization. Is this Alkali ever found Native? Common Mode of preparing it from the Lixivium of the Ashes of burnt Vegetables. *Lixivial Salts*, Alkalies so called and why. *Varieties* or Synonyma of the vegetable Alkali explained. Methods proposed to obtain the vegetable Alkali in Great Britain. Account of Mr. *Birch's* Mode of obtaining it from Dunghill Water. The Use of this Alkali in Arts, and in Medicine. A Proposal for employing it as an Antidote to the Poison of Corrosive Sublimate.

2. Of the VOLATILE ALKALI. It's general Alkaline Properties shewn by Experiments. It's specific Qualities. It's Volatility. Difficulty of melting or crystallizing it. Of it's Degree of Activity. It's Origin. It's native State. Conjecture that this Alkali is primarily an Animal Production. It's Synonyma or *Varieties*. The Identity of Volatile Salts. General Account of the *Causficity* of Alkalies,

Alkalies, See LECT. XIV. The Imperfection of Experiments made to shew the Causticity of Alkalies. Of the Use of Alkaline Salts in Medicine. Doubts concerning their septic Influence either externally or internally.

B. OF ACIDS. Tests of Acidity shewn by Experiments. 1. OF THE MINERAL ACIDS. Their Volatility. Their Attraction for Water. The Production of Heat in this Combination. Diminution of Heat in the Combination of Acids with Ice, See LECT. V. Of the *Rectification, Concentration, or Dephlegmation* of Acids. Fluidity not essential to the Mineral Acids. Instances of some of them being congealed and even crystallized. Their deleterious and their salutary Effects in the Body described.

a. OF THE VITRIOLIC ACID. It's Powerfulness. Distinction between the *Powerfulness*, the *Activity*, and the *Strength* of Acids. Specific Gravity of the Vitriolic Acid. It's Colour, and the Causes which influence it. Method of restoring it's Transparency, and some Phænomena observable in the Process. It's Attraction for Water, and the Mode of separating it's superfluous Water. Changes which the Acid undergoes in this Process. Improperly called *Oil of Vitriol*. Of the Origin and natural History of this Acid. Proofs that it does not exist in the Air or in Mineral Waters. It's Pretensions to the Title of the *Primogenial Acid* doubted. It's Synonyma. The Origin of these Appellations.

β. OF THE NITROUS ACID. It's great Volatility. It's specific Gravity. It's Appearance in the State of greatest Concentration. The red Colour not essential to it. It's Attraction for the Principle of Inflammability. Some Effects resulting from thence. It's Attraction for Water. The Change of it's Colour by Water shewn and explained. Of the
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the Origin and Natural History of this Acid. *Stahl's* Arguments to prove this Acid an Offspring of the Vitriolic considered. It's Synonyma.

γ. Of THE MURIATIC OR MARINE ACID. Derivation of it's Name. It's Colour and ordinary Appearance. It's Fumes. It's Distinction from the other Mineral Acids. It's weak Attraction for the Principle of Inflammability. It's great Volatility. *Stahl's* Arguments, to prove that this Acid is a Modification of the Vitriolic, examined. *Stahl's Mercurial Earth*. The natural Combinations of the Muriatic Acid.

δ. Of Mr. *Scheele's* ACID OF SPAR. An Abstract of the Experiments which led to this Discovery.

LECTURE XI.

2. Of THE VEGETABLE ACIDS. α. Of the *Native Acid of Fruits*. Their general Properties and Medicinal Qualities.

β. Of the *Acids produced by Fermentation*.

a. The *Acetous Acid*. b. The *Tartareous Acid*.

a. Of THE ACETOUS ACID OR VINEGAR. It's Inferiority in Strength. Of it's Rectification and Concentration : by Distillation ; by Frost. It's Synonyma. Of it's Crystallization. It's characteristic Properties not altered by Concentration. Of the Utility of this Acid in domestic Life and Medicine. Of it's great Use in the Armies of the Ancients. Dangers attending the liberal Use of this Acid in certain Circumstances of Health.

b. Of THE TARTAREOUS ACID or *Tartar of Wine*. It's Properties. It's Solidity. It's Infusibility. It's difficult Solution. It's Degree of Activity. Of the Alkaline Salt which it affords by
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Combustion. Is Tartar properly considered as a simple Acid? Mr. *Scheele's* Experiments to prove it a neutral Salt. The Production of Tartar in the vinous Fermentation : *Red Tartar* ; *White Tartar* ; Preparation of *Crystals* and *Cream of Tartar*. Observations on the Lees of Wine, and some Preparations made from it. *Frankfort Black*. 3. Of THE ANIMAL ACIDS. Probability of their Origin from some of the preceding Forms. *a. Of the Acid of Phosphorus*. It's Origin. It's Distinction from the vitriolic, nitrous, and marine Acids. Objections to *Stahl's* Opinion concerning it. It's peculiar specific Nature shewn by Mr. *Margraaff*. It's singular Properties. It's remarkable Fixity, the Cause of many of these Properties. *β. Of the Acid of Ants*. Mode of procuring it. It's Analogy to Vinegar. Of some other Acids generated or extricated in the Bodies of Animals. 4. Of THE ANOMALOUS ACIDS. Of the Acids of *Amber*, *Benzoine*, *Borax*. Of COMPOUND SALTS.

C. Of NEUTRAL SALTS ; formed by the Combination of the Acids and Alkalies. The Number of these. A Table of them and their Synonyma. Defects of these Tables. Of the Preparation of Neutral Salts. Of the Saturation of Acids and Alkalies. Tests of the Neutrality of Salts. Observations on the Syrup of Violets, and the Infusion of *Lacmus* or *Litmaſe*. Experiments. Neutral Salts prepared by Crystallization. Of their Mildness and Inactivity, compared with their original Acids and Alkalies. Of their Decomposition by Heat, and by Elective Attraction. Experiments. Of the *possible* Neutral Salts, which are either unknown, or have been unnoticed. Account of the Experiments of Dr. *Donald Monro*. *a. Of the Neutrals* formed by the Combination of Acid of Vitriol with

with Fixed Alkalies. *α.* With the fossil Alkali, *Glaubers' Salt*, and *β.* With the vegetable Alkali, *Vitriolated Tartar*. Of their Names and common Properties. *Stahl's* Mode of separating the Acid from these Salts. Difficulty of the Process. The distinguishing Properties of these Salts.

α. Of GLAUBERS SALT more particularly. It's Degree of Fusibility and Solubility. The Form of it's Crystals. Directions for attaining an Acquaintance with the Forms of Crystals. The Watery Fusion and Spontaneous Calcination of Glauber's Salt shewn. Of the Medicinal Virtues of Glauber's Salt. Of it's Origin. Enquiry whether it is ever found native in the Sea or in Springs. It's artificial Preparation. The Principles of it exhibited. *β.* Of VITRIOLATED TARTAR. It's Composition. Properties which distinguish it from Glauber's Salt. It's Difficult Fusibility and Volatility. The Form of it's Crystals shewn, and their Properties. Of it's comparative Inactivity. It's Medicinal Virtues and Advantages. It's Origin. The Mode of it's Preparation. Cautions on that Head. It's Synonyma. Cursory Observations on some Effects, which take Place in the Combination of saline and other Substances.

LECTURE XII.

Of Salts in Continuation. *b.* Of the Neutral Salts formed by the Union of the Nitrous Acid with the Fixed Alkalies *α.* With the Vegetable Alkali, *Nitre*. *β.* With the Fossil Alkali, *Cubic Nitre*.

α. Of NITRE. Arguments to prove, that the *Nitre* and *Natron* of the Ancients was not the Nitre here described. Testimonies from ancient Authors

on this Subject. The Properties of Nitre. It's Fusibility and Congelation. *Mineral Crystal*. Solubility of Nitre in hot and cold Waier. It's Crystals. It's Deflagration shewn. Of the Changes it undergoes in that Process. Production of *Nitrum Fixum*, and it's Qualities. Some Observations on the Theories, which have been deduced from the Deflagration of Nitre to explain the Cause of Thunder, Lightning, and Meteors. Of the *Clyffus* of Nitre, Sulphur, and Antimony. *Macquer's* Theory of the Deflagration of Nitre inadequate. The Difference of the Residuum, when different inflammable Substances are used. *Sal Polychrestus* and *Sal Prunellæ* how prepared. Their Composition, Qualities, and Synonyma. Of *Gunpowder*, See LECT. I. It's Composition and the Proportion of it's Ingredients. The Granulation of Gunpowder explained. Theory of it's Explosion. Cautions with Respect to the Preparation and Preservation of Gunpowder. Of *Pulvis Fulminans*. It's Composition and the Proportion of it's Ingredients. It's Preparation shewn. Phænomena of it's Detonation. Of the Analysis of Nitre. The Separation of it's Acid. The Residuum of the Process. The Separation of it's Alkali by Deflagration with inflammable Substances, and with crude Tartar. Preparation of the *White* and *Black Flux*. Their Properties. Of the *Crude Flux*. Of the Origin of Nitre. Enquiry whether it is ever found Native. The Observations of *Lemery*, *Boerhaave*, *Neuman*, *Watson*, and *Bowles*, on this Subject. Of the Modes of procuring it in Spain, in Germany, and in France. Of the Uses of Nitre in the Arts and in Medicine. It's singular antiphlogistic Virtue discussed.

b. Of

b. Of CUBIC NITRE. It's Preparation and the Form of it's Crystals. γ. Of the Neutrals formed by the Union of the Marine Acid with the Fixed Alkalies. a. With the Mineral Alkali, *Common Salt*. b. With the vegetable Alkali. *The Digestive Salt of Silviuſ.*

a. Of COMMON SALT. It's general Properties. It's Crystallization and the Form of it's Crystals. The Effects of Heat upon it. It's Decrepitation shewn. Of it's Conversion into Earth by repeated Boiling. Of the Separation of it's Acid. The Residuum. Separation of it's Alkali. Difficulty of the Process. Of it's dietetic and medicinal Qualities. Theory of it's operation in Digestion and Manure. Proofs that it does not cause the Sea Scurvy. Instances of the Fondness of all Animals for Sea Salt. Of it's Natural History: it's various Forms: 1. *Fossil or Rock Salt*; 2. *Spring Salt*; 3. *Sea Salt*.

1. Of *Fossil Salt*. Of the *Salt Mines* in England and other Parts of Europe. Description of the famous Mine in *Poland*. Of the Quantity of Salt annually raised from these Mines. The Origin of Fossil Salt investigated and some Theories concerning it refuted. Description of the Salt Mountain in *Catalonia*. Specimens of Rock Salt exhibited. Of the Method of preparing this Salt for Use.

2. Of *Salt Springs*, particularly those in England. The Strength of their Impregnation, particularly of the Springs at *Droitwich*. Of the Liquor remaining after the Preparation of Salt by simple Evaporation. *Bittern* or the *Mother-Water of Salt*. Of *Pan-Scratch*. 3. Of Sea Water, and the Strength of it's Impregnation in various Climates: See further LECT. 24. Of the Natural Separation of the

Salt from Sea Water. *Bay Salt*. Of the artificial Modes of preparing Common Salt. Different Methods of concentrating the Brine previous to the Evaporation : by Frost. Experiments of Mr. *Nairne* to prove, that the Ice of Sea Water contains no Salt. See LECT. 24. Method of concentrating the Brine at *Bevieux* and *Hall*. The common Mode of obtaining the Salt, illustrated by the Practice at *Droitwich*. Of the *Granulation* of Salt, and the Effect of resinous and oily Matters in this Intention. Rationale of this Effect. The best Method of preparing Salt for curing Provisions. Of the Purification of the Brine previous to these Processes.

LECTURE XIII.

OF the Contents of the *Bittern* or *Mother Water* of Nitre and Sea Salt. The Preparation of *Magnesia Alba* illustrated experimentally. History of this Discovery. Of the Detection of this Earth in the Epsom and other bitter purging Waters. The Mode of obtaining it from such Waters shewn by Experiment. Cautions concerning the Preparations of it. Cursory Observations on the Disputes, which have been maintained on this subject. Medicinal Virtues of *Magnesia*.

b. OF THE DIGESTIVE SALT OF SILVIUS. It's Preparation and Properties.

§. OF the Neutrals formed by the Union of the Volatile Alkali with the Mineral Acids : a. With the Vitriolic Acid, *Vitriolic Ammoniac*. b. With the Nitrous Acid, *Nitrous Ammoniac*. c. With the Marine Acid, *Sal Ammoniac*. Of Ammoniacal Salts in general. The origin of their Name. Their peculiar Qualities. Their Analysis.

a. Of

a. Of THE VITRIOLIC AMMONIAC. It's Properties with regard to Fire and Water. It's Crystals exhibited and their Phænomena shewn. It's Decomposition. It's Origin. *Glauber's* Discovery of it.

b. Of THE NITROUS AMMONIAC. The Effects of Heat upon it. It's singular Property of deflagrating without Addition shewn. Cautions against Attempts to sublime it &c, in close Vessels. It's Degree of Solubility and Crystallization. It's Decomposition. Various Modes of preparing it.

c. Of SAL AMMONIAC. It's Composition and Properties with Regard to Heat and Water. It's Volatility and the Properties dependant upon it. It's Solubility. The Production of Cold in this Solution, and the Degree of Cold so produced, See LECT. 5. Modes of distinguishing it from other Ammoniacal Salts. It's Decomposition shewn. *Volatile Salt* and *Spirit of Sal Ammoniac* how prepared. Of the native Production of Sal Ammoniac, and it's artificial Preparation. It's common Appearance, as imported, explained. It's Purification by Sublimation, or by Solution and Crystallization. It's Medicinal Virtues.

2. Of the Neutral formed by the Union of the Acetous Acid with the Vegetable Fixed Alkali. DIURETIC SALT or *Regenerated Tartar*. Reasons for preferring the former of these Titles. It's Preparation. It's Solution in Spirit of Wine. Of the Production of *Terra foliata Tartari* from this Solution, and the Reason of it's Name. Of the Solubility and Deliquescence of Diuretic Salt. It's Decomposition. It's Medical Virtues.

3. Of the Neutral formed by the Union of the Acetous Acid with Volatile Alkali.

SPIRIT OF MINDERERUS or the *Vegetable Ammoniac*. Propriety of the latter Name. It's Preparation.

paration. It's Volatility. It's Concentration. It's Decomposition. It's medical Virtues.

„ Of the Neutrals formed by the Union of the Acid of Tartar with the Fixed Alkalies.

a. With the Mineral Alkali, *Rochelle Salt*.

b. With the Vegetable Alkali, *Soluble Tartar*.

a. Of ROCHELLE SALT. It's Preparation. It's Crystallization. Crystals exhibited. Of it's Invention by Mr. *Seignette*. It's Taste and Medicinal Virtues.

b. Of SOLUBLE TARTAR or *Tartarized Tartar*. Propriety of the latter Title. It's Preparation. It's crystalline State. It's Properties. It's Decomposition. It's medicinal Qualities.

s. Of the Neutral formed by the Union of the Mineral Alkali with the Acid of Borax.

Of BORAX. Of it's Origin and natural History. Of *Tincal*. Specimens exhibited. Various Accounts of the Modes of procuring Tincal, and refining it into Borax. Proofs that Borax is a neutral Salt. Effects of Heat upon it. Glass of Borax. The Analysis of Borax. The peculiar Properties of it's Acid. Why called *Sedative Salt*. The Uses of Borax in the Arts. The medicinal Qualities of Borax and Sedative Salt. Some Proposals for making artificial Borax considered.

LECTURE XIV.

II. Of EARTHY SUBSTANCES. Some cursory Observations on the Theory of the Earth, and the Formation of Strata. Explanation of some Terms connected with this Subject. Of the Bodies included in this Class. Advantages of the chemical Mode of arranging Minerals. Of Mr. *Pott*'s Classification

sification of Minerals. Of the Arrangement adopted in Mr. *Bertram's Oryctologie*. Application and Improvement of these Systems, as far as concerns the present Plan. Earths defined. Mr. *Pott's* Division of the Earths into 4 Orders. 1. *Alkaline*. 2. *Gypseous*. 3. *Argillaceous*. 4. *Vitrifiable*. Examination of, and Objections to this Arrangement. *Cronstedt's* Division of Earths into 9 Orders: 1. *Calcareæ*. 2. *Siliciæ*. 3. *Granatiæ*. 4. *Argillacæ*. 5. *Micacæ*. 6. *Fluores*. 7. *Asbestinæ*. 8. *Zeolites*. 9. *Magnesia*. A short Account of these. An Attempt at an Improvement both of *Pott's* and *Cronstedt's* Method. Earths arranged under 4 Orders: 1. *Calcareous*. 2. *Crystalline*. 3. *Argillaceous*. 4. *Talky*.

I. OF CALCAREOUS EARTH. It's general Properties. It's universal Distribution shewn. Considered under two Genera: A. *Pure*. B. *Compounded*.

A. Species of *pure* Calcareous Earth. α . *Pulverized*, as Agaric Mineral or Lac Lunæ. β . *Soft and friable*, as Chalk. γ . *Indurated*, as Marble. δ . *Crystallized*, as Calcareous Spar. ϵ . *Precipitated*, as Stalactites.

B. Species of *Compound* Calcareous Earth. α . With the *Vitriolic* Acid, as in Gypsum, Alabaster, Selenites. β . With *the Principle of Inflammability*, as in Lapis Suillus, Lapis Hepaticus. γ . With *Argillaceous Earth*, as in Marle.

A more particular Account of some of these Species. Of *Spar*. Specimen of it exhibited. Of the Formation of *Stalactites*, *Stalagma*, *Osteocollæ*. Of the Origin of Petrefactions. Of the Combination of Calcareous Earth with the *Vitriolic* Acid. Of *Gypsum*. Effect of Fire upon gypseous Earths. Of *Plaster of Paris*. Some Observations on the Method of making Casts or Medals from
Medals,

Medals, Basso and Alto-relievos and Statues, in Plaster of Paris. Of the *Varieties* of Gypsum : a. *Foliaceous* Gypsum ; b. *Fibrous* ; c. *Granulated* ; d. *Crystallized*. Examples of these shewn. Of Alabaster, Selenites, and the Bolognan Stone. The Presence of Selenites in hard Waters. The Analysis of Gypsum pursued farther. The General Properties of Calcareous Earth resumed. The Effect of Acids upon it. Some natural Productions exhibited to illustrate certain Doctrines advanced. The Effect of Fire on Calcareous Earth. *Lime* or *Quick Lime*. Of the Solubility of Lime in Water. *Slaked Lime*. *Lime Water*. The Properties of Lime Water. Of the Calcination of Calcareous Earth for the Use of the Architect. Difference between Q. Lime and Crude Calcareous Earth. The Effect of Q. Lime on Alkalies and of Alkalies on Lime Water shewn by Experiments. *Spirit of Sal Ammoniac with Quicklime* how prepared. *Soap Lyes*, the Principle of their Preparation. Of Alkalies rendered caustic by Q. Lime. Their Properties and Operation externally and internally in the human Body. Some Observations on their Use in calculous Cases. Of the Change which Lime undergoes from Exposure to the Air. Of the Preservation of Lime and Lime Water. Of the Crust or Cream which forms upon Lime Water. Theories concerning the Change which Calcareous Earth undergoes in Calcination. Of the Absorption of igneous Particles according to *Lemery*, *Meyer* &c. Objections to this Opinion. *Dr. Black's* Doctrine of *Fixed Air*. History of this Discovery. Experiments which support it. Of the Medicinal Virtues of crude calcareous Earth. Observations on some pharmaceutical Preparations containing it.

LECTURE XV.

2. OF CRYSTALLINE EARTH. It's Synonyma explained. The common Characters of the Order. It's principal Genera enumerated: A. *Sand*. B. *Pebble*. C. *Quartz*. D. *Flint*. E. *Crystal*. Species of these Genera: A. Of *Sand*. Some of it's Species and Varieties shewn. B. Of *Pebble*. α . *Egyptian Pebble*. β . *Falkland Island Pebble*. γ . *Agate*. δ . *Onyx*. ϵ . *Sardonyx*. ζ . *Carnelian*. η . *Chalcedony*. θ . *Opal*. ι . *Mocho*. κ . *Breccia Silicea* or *Plumpudding Stone*. A general Account of these Species. C. OF QUARTZ. The Properties of α . *Quartz*, expressly so called. β . Of *Granite*. δ . Of *Basalt*. Description of the Giants Causeway, and the Basaltic Columns of *Staffa*. D. OF FLINT. α . *Flint* strictly so called. β . *Jasper*; of it's Impregnation and medicinal Use. γ . Of *Lapis Lazuli*; the Source of it's Impregnation, and the Preparation of Ultramarine Blue. E. OF CRYSTAL: α . Of the *Precious Stones*. a. *Diamond*. b. *Ruby*. c. *Sapphire*. d. *Topaz*. e. *Emerald*. f. *Chrysolite*. g. *Amethyst*. h. *Garnet*. i. *Hyacinth*. k. *Beril*. Reasons for not being particular on the Qualities of these. Cursory Observations on some peculiar Properties of the *Diamond*. β . Of *Crystals* strictly so called: The Forms of Crystals. Their Origin, Formation, and Situation. Of the Transmutation of other Earths into crystalline. Of the Combination of Crystalline Earth with Alkaline Salts by Fire. The Production of *Glass*, and the Phænomena attending it. Of the Proportion of the Ingredients employed. Phænomena which result from a Variation of these Proportions. *Liquor Silicum*. It's Production and Properties. Of the

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Preparation of the Materials used in making Glafs. *Fritt*. The natural Colour and Degree of Transparency of Glafs. Modes of dissipating the natural Colour of Glafs. Of *Manganese* or *Magnesia*. It's natural History and Properties. Explanation of it's Operation in destroying the green Colour of Glafs. The Preparation of Flint Glafs. Looking-Glass Plates. Common green Glafs. Window Glafs. Crown Glafs. Of the Method, and Materials used in *staining* Glafs. Of *artificial Gems*. PASTES. Of *Foils*. Of *Doublets*. Of *Enameling*. The Preparation of the White Enamel, and the Mode of painting on Enamel. The Art of *Painting on Glass* considered. It's Invention and History. Mr. *Walpole's* Observations. The Merits of Mess. *Jervais* and *Pearson* noticed. Of the Origin of the Art of making Glafs. *Pliny's* Account. Reference to Authors, who have treated more largely on the Art of making Glafs.

3. Of ARGILLACEOUS EARTH or CLAY. It's Universality, and it's general Characters. *Genera* of Clay: *α. Common Clay. β. Bole. γ. Tripoli Earth. δ. Porcelain Earth.* *α.* The Effects of Water and Fire on Clay. The Art of making Bricks &c. Effect of the kneading and pressing of moist Clay. Some Observations relative to Agriculture connected with this Subject. The Impurity of Common Clay. It's Colours, and their Causes. It's Purification. The Process of *Elutriation*. Observations on the Drying of moist Clay, either from natural or artificial Heat. Method of correcting the Inconveniences connected with this Cause. Of the Improvement of *Earthen Ware*. The Common Method of making earthen Ware. It's different Kinds: *White Stone Ware, Delft Ware, Queen's Ware*. The Composition and Glazing of these explained.

Proof

Proof that the Glaze of the Queen's Ware cannot be injurious to Health. Of the Experiments of Mess. *Pott*, *Margraaff*, and *Lewis &c.* on Clays. Of the Extraction of ALUM from Clay. Of the Minerals, which afford it. It's Species. *Roman Alum*, *Rock* or *Rock Alum*, *Plumous Alum*. Of the Solution of Alum. It's Effect on the blue Infusions of Vegetables. It's Crystallization. Effect of Fire on Alum. *Burnt Alum*. Analysis of Alum; by Fire; by Precipitation. It's Virtues in Medicine and in the Arts, particularly in dying. Theory of it's Operation.

L E C T U R E XVI.

β. Of BOLE. Description of it, it's various Forms, and Appellations. It's medicinal Qualities. Of the *Terræ Sigillatæ*.

γ. Of TRIPOLI Earth. It's Qualities. *Rotten Stone*, a Variety of it.

γ. Of PORCELAIN Earth. *Kaolin*, see the next Order.

4. Of TALK. Characters of the Order. Genera. α. *Mica*. β. *Asbestos*. γ. *Black Lead*. δ. *Soap Rock*. Specimens of these shewn. β. The particular Qualities of *Asbestos* enumerated, and the Uses to which it has been applied. γ. Of the Properties and Mode of counterfeiting Black Lead. Method of detecting the Fraud.

δ. The Qualities and Uses of the Soap Rock, particularly in making PORCELAIN. History of Porcelain, and the Discovery of this Method of imitating it in Europe. Account of the Chinese Earths, called *Kaolin* and *Pétuntse*. The Qualities requisite in perfect Porcelain. Of the Saxon Method of making Porcelain. The Excellence of

their Ware. Of the other, less perfect, European Methods. Defects of these Compositions, and the Cause of these Defects. Of the glazing, painting, and enameling of Porcelain. The great Superiority of the European to the Oriental Porcelain in these Points. Of the Improvement of common earthen Ware resulting from these Enquiries. Of Mr. *Wedgwood's* Manufacture.

III. OF INFLAMMABLE SUBSTANCES. Limits of this Class. Definition. Of the Presence of the Principle of Inflammability in all inflammable Substances. Of the *Orders* and *Genera* of this Class. 1. *Phosphorus* 2. *Sulphur*. 3. *Charcoal*. 4. *Ardent Spirits*. 5. *Oils*. 6. *Bitumina*.

1. PHOSPHORUS. The particular Consideration of it deferred to LECT. 27.

2. SULPHUR. It's Composition illustrated and proved. The Effects of Fire upon it. It's Fusion, and it's Sublimation. Of the *Volatile Acid of Sulphur* or *Spiritus Sulphuris per Campanam*. The Reason of that Appellation. Of the Preparation of Acid of Vitriol from Sulphur. Properties of the volatile Sulphureous Acid. Of the *Flowers of Sulphur*. The Action of Water on Sulphur considered. The Union of Sulphur with Fixed Alkalies and Quick-lime. Preparation of *Liver of Sulphur* shewn. Of the Solution of Liver of Sulphur in Water. Precipitation of Sulphur. Preparation of *Milk of Sulphur* shewn. Of the Combination of Sulphur with the Volatile Alkali. *Volatile Tincture of Sulphur* how prepared. Solution of Liver of Sulphur in Spirit of Wine. *Tincture of Sulphur* how prepared. Solution of Sulphur in Oils. *Balsams of Sulphur* how prepared. See LECT. 17. The Natural History of Sulphur. *Native Sulphur*. It's Difference from the *Sulphur Vivum* of the Shops.

Shops. Of the Minerals containing Sulphur. *Pyrites*. It's various Forms, *Fire Stone*, *Mundic*, *Marcasite*. Description of these. Specimens exhibited. The Method of extracting Sulphur from *Pyritæ* and metallic Ores. Of the Medicinal Qualities of Sulphur.

3. Of CHARCOAL. See also LECT. 5. It's Properties. It's Indestructibility shewn. Fossil Charcoal exhibited. Of the Ingredients which are separated from it by Inflammation. *Fixt Air*, See LECT. 14 and 24. The great Quantity of this Air contained in Charcoal illustrated by Experiment. Of the Composition of Charcoal.

4. Of ARDENT SPIRIT. It's Synonyma. Limitation of the Term *Spirit*. Spirit obtained from vinous Liquors only. Of the Rectification of Ardent Spirits. *Alcohol*. Assistant Means of improving the Rectification of Spirits.

L E C T U R E XVII.

Of the Strength of Spirits. Properties of highly-rectified Spirit. Of the Quantity of Water contained in the purest Spirit. Of *Proof Spirit*. Modes of trying the Proof of Spirits; by the Crown of Bubbles; by Oil; by Inflammation; by the *Hydrometer*. The Construction and Application of that Instrument illustrated. Defects of all these Modes. Attempts to correct them. Of the Combination of Spirit of Wine with Water. The Heat produced in the Mixture. See LECT. 5. The Degree of Attraction which takes place between Spirit of Wine and Water illustrated by Experiment. The Use of fixt Alkalies in the Rectification of Spirits explained. The Impregnation
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of Spirit with Alkaline Salts. Preparation of *Tartarized Spirit of Wine*. It's Colour and Properties Explained. Of the Union of Spirit of Wine with Volatile Alkali. Preparation of the *Offa Helmontii* and *Dulcified Spirit of Sal Ammoniac*. Of the Combination of Spirit of Wine with the Vitriolic Acid. The Degree of Heat generated shewn. See LECT. 5. Preparation of *Dulcified Spirit of Vitriol*. Cautions required in the Process. Of the Preparation of *Vitriolic Æther*. It's Properties. It's solvent Power. It's Inflaminability. It's Volatility. It's Use in Medicine. Observations concerning the Discovery of Æther. Of the *Anodyne Mineral Liquor of Hoffmann*. Of the *Eau de Rabel*. The Resemblance between these Preparations and Æther. Of the Combination of Spirit of Wine with the Acid of Nitre. Preparation of *Nitrous Æther*. Mr. *Woulfe's* Improvement. Of *Dulcified Spirit of Nitre*. It's Preparation and valuable medicinal Qualities. Of the Combination of Spirit of Wine with the Marine Acid. Preparation of *Dulcified Spirit of Salt*. Attempts to make *Marine Æther* by Mess. *Rouelle* and *Beaumé*. Success of the *Marquis de Courtanvaux*. His Process described. Improved by Mr. *Woulfe*. Of the Combination of Spirit of Wine with the Acetous Acid. Of *Count Lauraguai's Acetous Æther*. Of the Combination of Spirit of Wine with Acid of Borax or Sedative Salt. Experiment. The solvent Power of Spirit of Wine, and the Objects of it. It's Effect on animal Fluids and Solids both in and out of the Body. Dangerous Consequences from the liberal Use of Spirits internally.

5. Of OILS. The Extent in which this Term is used. General Qualities and Composition of Oils. Their Inflammation. Of *Soot*. Subdivision

sion of Oils into Genera. *a.* The *Aromatic or Essential Oils*. *β.* The *Unctuous or Expressed*. *γ.* The *Empyreumatic*. *α.* The Production of the essential Oils of Vegetables illustrated, with some cursory Observations on the Nature of Vegetables. See farther, LECT. 26. The *Species* of Essential Oils, and their distinguishing Characters shortly pointed out. Of the Changes which essential Oils suffer from Exposure. Of the *Spiritus Rectior* of Plants. Of the Rectification of Essential Oils. The Composition of these Oils: their Inflammation: their Analogy to Æther. Of their Combination with Fixt Alkalies. Preparation of *Soap of Tartar*. Of the Combination of Essential Oils with Volatile Alkalies. Preparation of the *Volatile Aromatic Spirit*, *Volatile Oily Spirit*, and *Eau de Luce*. Singular Effects of some of the Acids on essential Oils: exemplified with the vitrolic and nitrous Acids, and Oil of Turpentine. Of the Inflammation of these Oils by Acids. The slight Effect of the marine Acid shewn and explained. Of the Combination of these Oils with Sulphur. Preparation of *Turpentine Balsam of Sulphur*, and *Aniseed Balsam of Sulphur*. The supposed Virtues of these Preparations. Of the Combination of Spirit of Wine with Essential Oils. Of *Concrete Essential Oils*, (which may be called *Varieties* of Essential Oils,) particularly, *a.* *Camphor*. It's Properties enumerated. It's Analogy to, and it's Difference from, the fluid essential Oils. It's Volatility, Inflammability, Solubility in Spirit of Wine. Difficulty of decomposing it. The weak Action of Acids upon it. Of it's Origin, and the Method of collecting it. *b.* The *Native Balsams*; and *c.* *Resins*. Their Relation to the fluid Essential Oils shewn in their general Character. Their Solubility in Spirit of Wine.

Varnishes,

Varnishes, the Principle of their Preparation. Of the Improvements lately made in the Art of Varnishing. *Copal Varnish*. d. Of *Benzoine* or *Gum Benjamin*. The peculiar Qualities by which it is allied to, or differs from the Essential Oils enumerated. Of it's Origin. The Effects of Heat upon it. It's Sublimation shewn. Properties of the *Flowers of Benjamin*.

β. Of the UNCTUOUS OR EXPRESSED OILS. General Qualities. Some Remarks on their Effect in smoothing troubled Waters. Proofs both from ancient and modern Authors that this Fact was known long before Dr. *Franklin's* Memoirs appeared.

LECTURE XVIII.

Of the Change which Unctuous Oils undergo, when exposed to the Air. *Rancidity*. The Effect of Acids upon them shewn. Of their Combination with mild and caustic Fixt Alkalies. The Preparation of *Common Soap*. Of the Decomposition of Soap, and the Changes effected in the Oil. Of the imperfect Solution or curdling of Soap in some Waters. Explanation of this Effect, and the Nature of *Hard Waters* explained. See farther, LECT. 14 and 24. Of the Combination of Unctuous Oils with Quick Lime, and with Sulphur. Preparation of the *Simple* and *Barbadoes Balsams of Sulphur*. Danger attending their Preparation, and Cautions respecting their Use. The Effect of Heat on unctuous Oils. Their boiling Point. The Danger of these Operations. See LECT. 4. Of the Distillation or Rectification of Unctuous Oils. The particular Qualities of some *Varieties* of unctuous Oils, or Substances nearly allied to them, described.

a. Of

a. Of *Sperma Cete*. It's Origin, Qualities and Uses in Medicine. Effect of Heat upon it. It's Fusion and Mode of Concretion. Circumstances in which it agrees with, or differs from, unctuous Oils.

b. Of *Bees Wax*. It's Origin and Qualities. Effects of Heat upon it. It's Distillation. *Butter of Wax*. The Method of bleaching Bees Wax.

c. Of *Lac*. It's Origin. The Distinctions between *Seed Lac* and *Shell Lac*. Of it's Solution in Spirit of Wine, and it's Use in red Tinctures and Varnishes.

γ. Of EMPYREUMATIC OILS. Definition. The Origin, Preparation, and Rectification of these Oils. a. Of the *Animal Oil of Dippel*. b. *Oil of Box*. c. *Oil of Guaiacum*.

5. Of BITUMINOUS SUBSTANCES. The Extent of the Title. Genera of these : α. *Fluid*. β. *Solid Bitumina*.

α. Species of *Fluid Bitumina* : a. *Fire Damp*. See LECT. 24. b. *Petroleum*, or *Roek Oil*. Varieties of Rock Oil : a. *Naptha*. b. *Rock Oil*, strictly so called. c. *Bitumen Judaicum*. d. *Pissassphaltum*. e. *Barbadoes Rock Oil*. The latter Species consider as an Example of all these Varieties. Some peculiar Properties of Barbadoes Oil. It's natural History.

β. Of the *Solid Bitumina*, or fossil Inflammable Substances. Species of them : a. *Amber*. b. *Ambergris*. c. *Jet*. d. *Fossil Coal*.

a. Of AMBER. It's general Character. It's Electrical Property. It's Solubility and Inflammability. It's Distillation. *Spirit, Salt, and Oil of Amber*, how prepared. Experimental Proof of the Acidity of Salt of Amber. Conjectures concerning the Nature of this Acid. The Rectification

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and Properties of it's Oil. Medicinal Virtues of the Oil and Salt of Amber. Conjectures concerning the Origin of Amber.

b. Of AMBERGRIS. It's near Alliance to Amber. It's Qualities. It's Inflammability. It's Analysis. It's Origin.

c. Of JET. It's Alliance with, and Distinction from Fossil Coal. Conjectures concerning it's Origin. Confirmation of these from Mr. *Dillon's* Observations in *Spain*. Character and Qualities of Jet. It's Analysis.

d. Of FOSSIL COAL. It's Varieties; *a. Newcastle Coal.* *b. Pit-Coal.* *c. Cannel Coal.* Some general Observations on these, particularly the latter. The *Ampelites* of the Ancients nearly allied to Cannel Coal, and to Jet. Of the Analysis of Coal in general. Of the Oil which it affords by Distillation. Of the Fluid called *British Oil*. Account of it's Preparation. Of the Formation of Strata of Coal. Conjectures that they were originally formed from Vegetable Matter.

IV. Of METALLIC SUBSTANCES. The distinguishing Characters of this Class. Their Weight, Opacity, Non-Electricity, Splendor, Ductility, Malleability considered. The same of all these Properties. The Calcination of Metals. The Colour of *Metallis Calces*. More particular Explanation of these Terms. Phænomena attending the Calcination of Metals in different Cases. The Fusion of Metals, and the Means of promoting or retarding it. Observations on the Earth of Metallic Calces. Of their *Vitrification* and *Scorification*. Of the Increase of Weight acquired by Metallic Calces. The Arguments of *Boyle*, *Muschenbroek*, *Rey* and *Lavoisier* considered. Objections to them. Conjecture that this Addition of Weight depends upon
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the Expulsion of the Inflammable Principle. Confirmations of this Theory from the Phænomena of Calcination, the Nature of the Inflammable Principle, and the Properties of Light. Of the *Reduction* of Metallic Calces. Phænomena attending this Reduction and the Modes by which it is facilitated. Of the Use and Operation of *Fluxes*. Of the Loss of Weight in Metals thus reduced. Some further Observations on *Stahl's* Theory of the Mercurial Principle.

LECTURE XIX.

General Properties of Metals farther considered. Of the Action of Acids upon them. The Phænomena which attend it. Of the Degree and Order of Attraction subsisting between Metals in general and Acids. Of the *Precipitation* of Metals by other Metals. Examples of this exhibited. Of the elastic Vapour discharged in the Solution of Metals. *Inflammable* and *Nitrous Air*: See LECT. 24. Of the Acrimony of Metallic Salts and it's Cause. Imperfect Theories advanced on this subject. Of the Effect of Alkalies and Neutral Salts on Metals. The use of Borax in promoting their Fusion. Of the *Deflagration* of Metals with Nitre shewn by Experiment. Of their *Volatization* by Sal Ammoniac. Of the Combination of metallic Calces with Earths and inflammable Substances. Of the Attraction of Metals to Sulphur. Effects of this Union. Of the Action of Metals on each other. Of *Soldering*. General Account of the Principles on which it depends. Of the Changes which Metals suffer from Exposure to the Air. The Nature of *Rust* and *Tarnish* explained. Of the Origin of Metals, and their native State, See

LECT. I. Of Ores, and their general Forms. Of the Method of discovering *Mines*. Absurd Opinions concerning the Efficacy of the *Divining Wand*. Of *Mineralization*, and the Substances with which Metals are mineralized. Of the *Veins* containing Ores. Of the *Matrix* of Ores. Of ARSENIC. It's peculiar Qualities. It's Fusibility and Volatility. It's Fumes condensed: *White Arsenic*: how reduced to a semimetallic State. *Regulus of Arsenic*. Explanation of the Term *Regulus*. Of the Solubility of White Arsenic. It's Analogy to Salts. It's Power of promoting the Fusion of Metallic Calces and Earths. It's Use and Effect in the Preparation of Glafs. It's Combination with Sulphur by Sublimation. *Yellow Arsenic*. *Red Arsenic*. The different Colours of these Preparations and their Inactivity explained. Native Compounds of Sulphur with Arsenic exhibited. *Orpiment*, *Zarnisc*, *Realgar*, *Sandarach*. The Degree and Order of the Attraction of Arsenic to metallic Substances. It's Uses in various Arts. It's *Natural History*. The Mode of obtaining it by Sublimation from Cobalt. Of the Operation of White Arsenic in the Animal Body. Exemplified in Dr. *Addington's* accurate Account of the Case of Mr. *Blandy*. Cautions suggested by these Remarks. Of the Modes of discovering whether Arsenic has been administered. Remarks on the Danger of using Arsenic as a Medicine. Modes of obviating or removing it's Effects.

The Account of Metallic Ores resumed. Method of separating them from their Matrix described. The Operations of *Budling* and *Stamping*, *Crude Melting*, and *Roasting* of Ores explained. Of the *Rapacity* of Sulphur and Arsenic. Of the *Purification* and *Refinement* of Metals. Of the *Assay* of

of metallic Ores. Subdivision of Metals into Orders, Genera, and Species: 1. *Fluid Metallic Substances*. 2. *Solid Metallic Substances*. Of the 1st Order, *Mercury* is the only Genus and Species. Genera of the 2nd Order: *a. Semimetals*. *β. Imperfect Metals*. *γ. Perfect Metals*, *a. Species of semimetals*. *a. Antimony*. *b. Bismuth*. *c. Zinc*. *d. Cobalt*. *e. Nickel*. *f. Platina*. *β. Species of Imperfect Metals*. *a. Lead*. *b. Tin*. *c. Iron*. *d. Copper*. *γ. Species of Perfect Metals*. *a. Silver*. *b. Gold*.

I. Of MERCURY. *Quicksilver, Argentum Vivum*. §. It's general Appearance and Properties. It's specific Gravity. Fusibility. Volatility. Attempts to fix it. It's Congelation, See LECT. 3. It's *Natural History*. It's Ores. *Cinnabar*. The Qualities and Composition of *Cinnabar*. Of the Mode of extracting Mercury from it's Ore. It's Purification. Pharmaceutical Preparations of Mercury. The Effect of Trituration on Mercury. It's Sublimation and Calcination. *Mercurius Calcinatus* or *Merc. præcipitatus per se*, how prepared. The Action of the Vitriolic Acid on Mercury. *Mercurius Emeticus flavus* or *Turpeth Mineral*. It's Qualities. The Action of the Nitrous Acid on Mercury. *Solution of Mercury*: evaporated. *Calx of Mercury*. Preparation of *Mercurius Corrosivus Ruber* or *Red Præcipitate*. It's Use and Application. Attempts to improve it for internal Use. *Mercurius Corallinus*; *Arcanum Corallinum*, and *Panacea Mercurii rubra*. The Action of the Marine Acid on Mercury, and the Mode of Effecting it. Of *Corrosive Sublimate*. It's external Use. *Van Swieten's* Method of administering it internally. Preparation of *Mercurius dulcis*; *Calomel*; and *Aquila Alba*. Efficacy of these Preparations. Unnecessary Attempts to improve them in the *Panacea Mercurii*. Of the
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Precipitation of Mercury. Preparation of *White, Brown, and Green Precipitates* of Mercury. Of the Combination of Mercury with absorbent Earths. *Alkalized Mercury*. *Plenk's Method* of extinguishing Mercury with Mucilage of Gum Arabic. Of it's Extinction by unctuous Oils and Fats. *Mercurial Ointments and Plasters*. Of the Combination of Mercury with Sulphur. *Fæctitious Cinnabar*. *Æthiops Mineral*. Of the Efficacy of Mercury in the Cure of the Venereal Disease. Conjectures concerning it's Mode of Operation. The History of it's Employment in this Intention farther considered. See LECT. I.

LECTURE XX.

α. Of the SEMIMETALS. a. ANTIMONY β. It's Ores. *Crude Antimony*. It's Properties, Fusibility, and Volatility. Natural History of Antimony. It's Pharmaceutical Preparations. *Prepared Antimony*, how made. Calcination and Vittrification of Antimony. *Glass of Antimony*. Of the Separation of the Sulphur of Crude Antimony by Solution in Aq. Regia. By Deflagration with Nitre. *Crocus of Antimony*, how prepared, and why so called. *Washed Crocus*. *Calx of Antimony*. *Diaphoretic Antimony*. *Nitrated Diaphoretic Antimony*. *Washed Diaphoretic Antimony*. *Antimoniated Nitre*. *James's Powder*. The Preparation and general Qualities of all these Forms. Of the *Regulus* of Antimony: why called *stellated*; *martial*; *medicinal*. Of the Præcipitation of the Sulphur from a Solution of the Scorix of the above Processes. *Præcipitated or Golden Sulphur of Antimony*. *Kermes Mineral*. Efficacy of the Combinations of this Sulphur with Mercury. *Plummer's*

Plummer's Pill. Combination of Antimony with the Marine Acid. *Antimonial Caustic.* *Butter of Antimony*: separated by Spirit of Nitre. *Bezoar Mineral.* Combination of Antimony with the Vegetable Acids; with the Acid of Wine; *Emetic or Antimonial Wines*; with Tartar; *Emetic Tartar.* The Efficacy of these Forms. Hints for their more accurate Preparation. The Excellence of an Emetic Tartar prepared by Mr. Jenner of Berkeley. Of the extensive Virtue of Antimony in general. It's Medical History.

b. Of BISMUTH. It's Ores. It's *Regulus* how obtained. It's Appearance; Fusibility; Volatility; Calcination; Reduction; Solution in Aq. Fortis. It's Precipitation by simple Water shewn. *Magistery of Bismuth.* Explanation of the Term *Magistery.* *Pearl White*; *Pearl Powder*; *Blanc de Fard* how prepared. Ill Consequences of the Employment of this Powder. Of the Solution of Bismuth in some other Acids. Of it's Union with Sulphur; and with other Metals, particularly Mercury. Explanation of the Term *Amalgamation.* Of the Adulteration of Mercury with Bismuth. The Use of Bismuth in the Arts.

c. Of ZINC. It's specific Gravity compared with that of Bismuth. Distinction between Zinc and Bismuth. The Degree of Fusibility and Volatility of Zinc. *Flowers of Zinc* prepared. It's Inflammability. Difficulty of reducing it's Calces. Of the Action of Acids upon it; of the Vitriolic, and Marine. Inflammability of the Vapour discharged in this Process, see LECT. 23. It's Separation from other Metals by Sulphur. It's Use in the Arts. The Composition of *Brass* and *Tutenag* explained. Of the Ores of Zinc. *Calamine Stone.* Of some Calces, Sublimates or Preparations of Zinc,

Zinc, which are not well understood : *Cadmia Fornacum* ; *Tutty* ; *Pomphelix* ; *Nibil Album*. Of the Use of the Flowers of Zinc in Medicine. Of *White Vitriol*. Specimens native and factitious exhibited. Their Virtues. Observations on the common Method of applying the Preparations of Zinc.

d. Of COBALT. It's Ore exhibited and described. Method of expelling the Arsenic from it, see LECT. 19. The Residuum. *Smalt* and *Zaffre* how prepared ; their valuable Qualities. Preparation of the *Regulus of Cobalt*. It's Calcination. Uses of this Calx. It's Solution in Aq. fortis. *The Sympathetic Ink of Cobalt*. An improved and easy Method of making it shewn. The singular Properties of this Ink exhibited. Of the Solution of Cobalt in Acid of Vitriol.

e. Of NICKEL. It's Ore exhibited. *Copper Nickel*. *Cronstedt's* Account of this Mineral. The Appearance of it's *Regulus* ; it's specific Gravity. It's Calcination and Reduction. It's Solution in Acids. It's Attraction for Sulphur and Metallic Substances.

f. Of PLATINA. Impropriety of placing it here. The Reason for this Arrangement. History of it's Introduction into Europe. *It's Origin and Native State*. It's Name, whence derived. Proofs of it's Purity. It's Degree of Fusibility, Malleability. Of it's Claim to the Title of a perfect Metal. It's Combination with Liver of Sulphur. It's Solubility in Aqua Regia only. It's Crystallization, Precipitation. See further, LECT. 23.

β. Of the IMPERFECT METALS.

a. Of LEAD. *Plumbum*, *Saturnus*. γ. It's general Character. Observations on the Softness, Ductility, and Malleability of Metals. The specific Gravity of Lead. It's Fusibility and Granulation.

lation. Of the Metals which are susceptible of Granulation, and the Modes of effecting it. The Method of making *Shot*; and of casting Lead in *Sheets*. Calcination of Lead. *Plumbum Ustum*. *Litharge*. *Litharge of Silver and Gold*. Impropriety of these Names. Calcination of Lead urged farther: *Masticot*; *Minium* or *Red Lead*. Of the Reduction of these Calces. Of the Action of the Acids on Lead. It's superior Attraction for the Vitriolic Acid. Application of this Observation. Solution of Lead in the Nitrous Acid, and Crystallization. The Action of the Marine Acid on Lead. Preparation and Properties of *Plumbum Corneum*. Of the Corrosion or Solution of Lead by Vegetable Acids. Preparation of *Cerusse* or *White Lead*, and *Sugar of Lead*. Decomposition of these Solutions by Alkalies; by Heat. Some Effects of caustic Alkalies, and Neutral Salts on Lead.

LECTURE XXI.

Effect of the Calces of Lead in promoting the Fusion of Earths. Application of this Property in various Arts. Of the Reduction of these Calces. Of their Combination with inflammable Matters particularly Oils. The Basis of *Plasters*. The Attraction of Calces of Lead for Sulphur, and the Mode of separating them. Of a *Sympathetic Ink* made with Solutions of Liver of Sulphur or of Orpiment. *Liquor Vini Probatorius*. Experiments. Of the Combination of Lead with other Metals, and some Effects thence resulting. Some *Ores of Lead* exhibited: *Common Lead Ore*; *Thorn-leaved Ore*; *Peacock Ore*; *Steel grained Ore*; *White Lead Ore*; *Cat's Tooth Lead Ore*. Mode of obtaining
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the Metal from them. Of the Medicinal Qualities of Lead, and it's general Effects. Account of the Disorders to which Operators in it are liable. Of the *Mill-reck* &c. The *Colic of Poitou*, *Barbadoes*, *Devon*. State of the Dispute on that Subject. Medicinal Preparations of Lead, their Virtues and Use. *The Saturnine* or *Antiphthifical Tincture*. *Goulard's Extrait de Saturne*, and *Eau Vegeto-Minerales*.

β. Of TIN. *Stannum*, *Jupiter*. 4. It's Metallic Appearance, and Character. It's specific Gravity. It's Malleability. Of *Tin-foil*. It's Flexibility, and the Cause of the crackling Noise, which attends it. It's Resistance to common Solvents. Of the *Tinning* of domestic Vessels. The Fusibility of Tin. It's Granulation; *Pulvis Stanni*. It's Calcination; *Calx Jovis*. The Use of this Calx in Enameling. The Action of the Acids on Tin; the Vitriolic; the Nitrous. Difficulty of procuring a perfect Solution. Of the Use of this Solution in Dying. Of the Action of the Marine Acid on Tin. Preparation of the *Liquor fumans Libavii*. The Inactivity of the Vegetable Acids on Tin. The Advantage and Security of tinning Copper Vessels. Combination of Sulphur with Tin. Preparation of *Aurum Mosaicum* vel *Musivum*. The Combination of Tin with other Metals. It's particular Effects on Silver and Gold. The Principle upon which it's Use in casting Bell Metal depends. Observations on the Fusibility, which it communicates to other Metals. *Natural History of Tin*. Proof that it is sometimes found Native. The common Forms of *it's Ore* exhibited. The Mode of working it. Difficulty of separating it's Arsenic. Dr. *Lewis's* Theory, deduced from thence, of the Operation of Tin as a Vermifuge.

γ. Of

γ. Of IRON. *Ferrum*, *Mars*. δ. It's Hardness; Elasticity; Malleability; Ductility. It's subjection to the Influence of the Magnet; The Effects of Heat upon it. It's Fusibility. It's *Coruscation*, when red hot, shewn. The Operation of *Welding*. Of the Calcination of Iron. *Croci Martis*, why so called. Of the Saline Solvents of Iron. The Action of Air and Water upon it. The Modes of securing it from these. The Method of *Reaumur*, and others. The modern *Steel Preservative*. The Action of the Vitriolic Acid upon Iron. The Inflammability of the Vapour discharged, exhibited; See farther LECT. 23. This Solution of Iron evaporated to Crystallization: *Green Vitriol*, *Sal Martis*, or *Copperas*. Properties of these Crystals. Effect of Fire upon them: *Calcined Vitriol*; *Vitriol calcined to Redness*; *Colcothar of Vitriol*. Of the Distillation of Vitriolic Acid from Green Vitriol; from Pyrites, See farther LECT. 16. Of the Action of the Nitrous Acid on Iron. Cautions requisite to obtain a perfect Solution. Of the Action of the Marine Acid on this Metal. Effect of Heat on this Solution; Sublimate. Precipitation from Exposure to the Air; *Ochre*. The Cause of it. Of the Action of the Vegetable Acids upon Iron: *Chalybeate Wines*, and their Disposition to Muddiness and Precipitation. Of the natural Precipitation of Iron on the Banks &c. of chalybeate Springs. Of the yellow Colour in dyed Linens. The Precipitation of Iron by Alkalies: by the *phlogisticated* Alkali. The Preparation of this Alkali, and the Process for preparing *Prussian Blue*. Account of some natural Precipitates of this Kind. The Precipitation of Iron by astringent Vegetables. Of *Ink* and *black Dyes*. These important Objects farther illustrated both by

Theory and Experiment. Of the Ingredients employed, and their Proportions, in making Ink. Causes of the Decay of Ink, and the Modes of preventing it. Method of recovering decayed Writings. The principal Vegetable Astringents enumerated. Comparison of their Strength. Another Species of *sympathetic Ink*. Some Observations on the Colour produced by adding Solutions of Iron to Infusions of Peruvian Bark. Of *the Ink of the Ancients*. Some Proofs of it's great Durability, from Writings found at *Herculaneum*. Explanation of this Fact. Of *Indian and Chinese Ink*. Dr. *Lewis's* Observations on these Subjects. Of the Deflagration of Iron with Nitre. The Action of Sal Ammoniac on Iron, *Flores Martiales*. The Action of Sulphur on Iron; *Chalybs cum Sulphure*. The Effect of moistening a Mixture of Flowers of Sulphur and Filings of Iron: *Artificial Earthquake*. The Residuum of this Process examined. Of the natural Resolution of Pyritæ. Origin of *native Green Vitriol*; Specimens of native Green Vitriol and *Plumous Vitriol* exhibited. Application of these Phænomena to the Explanation of *subterraneous Fires, Volcanoes, and Hot Springs*. Of the Combination of Iron with other Metals. Of the Super saturation of Iron with Phlogiston. The Preparation of *Steel* by Cementation. Theory of this Process. The Properties of Steel. Of the *Tempering* of Steel, and it's Reduction to the State of soft Iron. *M. Reaumur's* Memoirs on this Subject. Of *Cast Steel*. Of *the Ores* of Iron: Their Universality. Some of it's common Forms and Appearances shewn. It's Presence in the Fluids and Solids of Animals and Vegetables: Memoir of *Menghini* in the Bolognan Commentaries on that Subject. Of *Ocbres*, their Use in dying. Of
Lapis

Lapis Hæmatites ; it's supposed styptic Virtue. Of *Manganese*, See LECT. 15. Of the *Magnet*. Of *Emery*. Of the Roasting and Smelting of Iron Ores. Of *Cast Iron*. It's Texture and Qualities. Of the *forging* of cast Iron. Mr. *Reaumur's* Experiment related. Of the Superiority of the British Iron and Steel Works.

LECTURE XXII.

Of the Medicinal Virtues of Iron. Theory of it's Operation with an Attempt to distinguish between tonic and simply-astringent Medicines. It's Influence exerted in the first Passages. Proofs that it does not enter the Lacteals. Some Disorders which require chalybeate Medicines enumerated. The Contra indications to it's Use mentioned. Of some of it's most efficacious Forms, their Preparation and comparative Virtues. *Chalybeate Waters*. *Lapis Hæmatites pulverizatus*. *Steel Filings*. *Rust of Iron*. *Lemery's Martial Æthiops*. *Green Vitriol*; some Cautions respecting it's Preparation. The *Styptic Tincture*; some Observations upon it. *Calcined Vitriol*. *Colcothar of Vitriol*. *Chalybs cum Sulphure*. *Mars Sulphuratus*. *Croci Martis aperiens et astringens*. *Tincture of Steel in Spirit of Salt*. *Martial Flowers*. *Tincture of Martial Flowers*. *Lixivium Martis*. *Lixivium Martis* five *Oleum Martis per Deliquium*. *Chalybs Tartarizatus* five *Mars Solubilis*. *Mars Solubilis Alkalizatus*. *Chalybeate Wine*.

§. Of COPPER. *Cuprum*, *Æs*, *Venus*. ♀. It's General Appearance. It's Degree of Strength, Rigidity, and Malleability. It's Calcination and Fusion. Some Phænomena particularly connected with it's State of Fusion. It's Solution in Acids :
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in the Vitriolic. Crystallization. *Blue Vitriol*. It's Solution in the Nitrous, Marine, and Vegetable Acids. Of the Preparation of *Verdigris*. *Crystals of Verdigris*. Decomposition of these Crystals by Heat. Distillation of *Radical Vinegar*, *Acetum Æruginis*, or *Spirit of Venus*. It's Qualities and Degree of Strength. Precipitation of Copper by Fixed Alkalies. Preparation of *Verditer*. By the Volatile Alkali: the Use of the Volatile Alkali in discovering Copper in Solution. The Preparation and Virtues of *Cuprum Ammoniacum*. The Precipitation of Copper by Iron illustrated by some singular Phænomena. Deflagration of Copper with Nitre. It's Sublimation with Sal Ammoniac. Remarks on *Boyle's Ens Veneris*. Proofs that it is a chalybeate and not a cupreous Preparation. Solution of Copper with Sal Ammoniac in Lime Water. *Aqua Sapphirina*. Combination of Copper with Arsenic: *White Copper*; *White Tombac*: with Zinc: *Brass*; *Pinchbeck*; *Princes Metal*; *Similor*; *Tombac*; *Bell-Metal*. Proportions of Copper and Zinc in these Preparations. The Natural History of Copper. *Cupreous* or *Ziment Waters*. Some Copper Ores exhibited. Of *Native Copper*. *Blistered Copper Ore*. *Mountain Green* and *Blue Lapis Lazuli*. *Turquoise Stone*. *Common black and grey Copper Ores*. The Extraction of Copper from it's Ore, and it's Refinement: *Red Copper*; *Black Copper*; *Rose Copper*. The Medicinal Operation of Copper. It's deleterious, and it's salutary Effects described. Method of obviating the Effects of the Poison of Copper. The Merit of Dr. Falconer on this Subject.

γ. OF THE PERFECT METALS. a. *Silver*. b. *Gold*. Why called perfect. General Account of the Properties of Silver and Gold. Their amazing Ductility

Ductility and Malleability, illustrated by the making of Gold and Silver Wire, and Gold and Silver Leaf. Experiments of *Halley*, *Boyle*, *Reaumur* &c. related. Their Resistance to artificial Fire. Of their Volatilization. *Homburg's* Experiments examined. Of their Resistance to the Action of Nitre and Lead. Observations concerning Cupellation.

a. Of SILVER. *Argentum*, *Luna*, *Diana*. D. It's specific Gravity. It's Ductility. It's Change on Exposure to Air. It's Fusion. Phænomena observed in it's Congelation. It's *Vegetation* explained. The Action of Acids upon Silver; of the Vitriolic. The Acid of Nitre the proper Menstruum of Silver. Of it's Solution. Circumstances which are apt to impair it's Colour. It's Properties. It's Effect on animal Substances explained. It's Crystallization. *Crystals of Silver* shewn. *Fel Metallorum*. *Causticum Lunare* or *Infernal Stone*. It's Use in Medicine and Surgery. Of the Reduction of Calces of Silver. Of the Action of Marine Acid on Silver. Proofs of the strong Attraction of the Marine Acid for Silver. Of the Insolubility (in Water) of Silver united with the Marine Acid. A Test of the Presence of Sea Salt or Marine Acid in Waters. Properties of the Precipitate. Preparation of *Luna Cornea*. Difficulty of preparing and preserving it perfect. Precipitation of Silver from the Nitrous Acid by Spirit of Vitriol. Observations on the common Method of purifying Silver by Solution in Aqua Fortis. Method of perfecting this Purification. Of other Modes of separating Silver from it's Solution in Spirit of Nitre; by Alkalies; by Metals; by Deflagration; by Evaporation to Dryness; Precipitation, and subsequent Fusion with Borax. Examination of these Modes. The Precipitation by Copper generally pre-

ferred : why and how performed. Precipitation of Silver by Mercury- Phænomena attending this Precipitation. Of the *Arbor Dianæ*. Of the Precipitation of Silver from Luna Cornea. Mode of silvering Dial Plates. Of the Use of the Precipitates of Silver in enameling. Of the Attraction of Silver for Sulphur, and the Separation of the former from Gold by this Means. Of the Attraction of Silver for other Metals. The Order of these Attractions, and the Uses to which they are applied. *The Natural History* of Silver. *Native Silver*. Silver Ores. An Attempt to consider them under a few Heads. The Method of extracting the Silver from these Ores, and the Use of Lead in these Processes. Of the Quantity of Silver contained in Lead Ores ; particularly those of this Country. Consideration of the Value of the Silver Mines to Spain, and the comparative Advantages, which we enjoy without them.

L E C T U R E XXIII.

b. Of GOLD. *Aurum, Sol.* ☉. Some remarkable Instances of it's Softness. It's specific Gravity. It's Expansibility. It's Fusion. It's Resistance to Calcination. Of the Action of Acids upon it. It's Resistance to the Vitriolic, Nitrous, and Marine Acids separately. The Nature and Use of the *Lapis Lydius*, or *Touchstone*. Of the Refinement of Gold by Cementation with Nitrous Salts. Of the Solution of Gold in Aqua Regia. Composition, Preparation, and Mode of Action of Aqua Regia. Proof of the solvent Power of the Marine Acid in this Composition. Of the Precipitation of Gold from this Solution. Preparation
and

and Properties of *Aurum Fulminans*. The Degree of it's fulminating Power. Of the Theories adduced to explain it's Fulmination. Objections to most of these. The Theory of Fixt Air applied. Modes of destroying it's fulminating Power. Other Modes of separating Gold from it's Solution; by Æther and Essential Oils; by Metals. The Precipitation of Gold by Means of Green Vitriol. The Use of this Precipitate in the painting of Porcelain and Enamel. The Precipitation of Gold by Solution of Mercury in the Nitrous Acid. Precipitation of Gold by Tin. Beauty and Value of the Precipitate. *Calx Cassii*, why so called, and it's Use in staining Glass of a ruby Colour. Of the Separation of Gold from other Metals by Means of Sulphur, particularly in crude Antimony. Of the Solution of Gold by Means of Liver of Sulphur. *Stahl's* Theory of the Destruction of the Golden Calf; partly considered. Considered in LECT. 1. Of the separation of Gold from Liver of Sulphur. Of the Combination of Gold with other Metals. It's Amalgamation with Mercury. Application of this Preparation in various Arts. Of *Gilding and Burnishing* in general. Of the Effect of Tin in destroying the Ductility of Gold. Combination of Gold with Silver and Copper. Explanation of the Terms *Alloy* and *Carat*. The Refinement of Gold by Cementation: by Fusion with crude Antimony: by Cupellation: and by Aq. Fortis. Rationale of these Processes. Explanation of the Terms, *Quartation* and *Parting*. Of the three Modes of *Parting*: *Simple Parting*: *Concentrated Parting*: *Parting à la Voie Seche*. These Processes explained. Of the Attraction of Gold for *Platina*, See LECT. 20. Difficulty of separating them. Experiments of *Lewis*, *Scheffer*, and

Margraaff, with this View. This Separation effected by Mercury, by Alkalies, by Sal Ammoniac, by Ardent Spirits, by Essential Oils and Æther, by Green Vitriol. The Mode of employing these Substances, and their comparative Advantages. *Natural History of Gold*. It's Mines. Instances of the largest Specimens of Gold Ore. Of the Gold Sands of the Rivers of *France* &c. The Method of obtaining the Gold from these Sands, and from it's stony Ore. The Uses to which Gold has been applied in Arts and in Medicine. Of the various Attempts to procure a true *Potable Solution of Gold*.

V. OF AERIAL BODIES. Explanation of this Title. The Observations of *Van Helmont*, *Boyle*, and *Hales*, related. General Remarks on the Nature of Elastic Fluids. The Meaning and Application of the Term *Gas*. The *Genera* of permanently elastic Fluids, which are best established. *α. Fixed or Fixible Air. β. Inflammable Air. γ. Nitrous Air. δ. Dephlogisticated Air. ε. Acid Air. ζ. Alkaline Air. η. Atmospheric Air.* Some general Remarks on the Origin and Sources of these.

α. Of FIXED AIR. History of it's Discovery. LECT. 11. and 14. The Cause of the Causticity of Alkaline Salts, and Quick Lime recapitulated. Substances which contain Fixed Air. Modes by which it may be extricated, collected, and transferred from one Body to another. Of it's Restoration to Substances, whence it has been expelled. Proofs of it's Identity in all Cases. Experiments to illustrate these Positions. The Order of it's Attraction for the various Substances, which contain it. Some Effects dependant upon this Order of Attraction related. Of the Impregnation of Water with Fixed Air. The Properties of Water

fo impregnated. The Impregnation of the *Acidulæ* of Physicians explained. See farther LECT. 24. Of the Solution of Iron in Water by Means of Fixed Air. Experiment. The Solution of Mild Calcareous Earth in Water by Means of Fixed Air shewn by Experiment. The Modes of separating Fixed Air from Water. The prejudicial Influence of this Air inhaled by Animals, evinced by the Accounts of Brewhouses, Cellars, subterraneous Caverns, and particularly the *Grotto del Cane* near *Naples*. Specific Gravity of Fixed Air, and it's Power of extinguishing Flame shewn by Experiment. The Medicinal Virtues of Water impregnated with Fixed Air.

LECTURE XXIV.

β. Of INFLAMMABLE AIR. It's distinguishing Quality. Enumeration of some of it's *Species*. Of the *Fulminating* or *Fire Damp*. It's common Appearance and the Phænomena of it's Fulmination described. It's dangerous Effects. Mr. *Spedding's* Contrivance at *Whitehaven* to prevent it's Fulmination. Modes of destroying or expelling it from Mines. Of the *Inflammable Vapours exhaled from Marshes*. The Common Mode of procuring inflammable Air shewn. It's Inflammation by the Electric Spark. Sig. *Volta's* Theory concerning Meteors. *Priestley's* and *Keir's* Enumeration of the *Species* of inflammable Air. Conjectures concerning the Composition of inflammable Air. It's Influence on vegetable and animal Life.

γ. Of NITROUS AIR. The Mode of generating it shewn. It's Effect in diminishing the Bulk of Atmospheric Air. Of the Construction

and Use of *Eudiometers*. The Effect of Nitrous Air on Vegetables. Of the Preservation of Animal Matters from Putrefaction by Nitrous Air.

δ. Of DEPHLOGISTICATED AIR. The Meaning of it's Name. Dr. *Priestley's* Discovery of it, and the Mode of generating it. It's Properties.

ε Of ACID AIR. a. *Vitriolic Acid Air*. b. *Nitrous Acid Air*. c. *Marine Acid Air*. A short Account of each of these.

ζ. Of ALKALINE AIR. A short Account of it.

η. Of ATMOSPHERIC AIR. It's Degree of Purity. It's Impregnations. It's chemical Qualities. It's solvent Power, see LECT. 4. It's Renewal necessary to Respiration and Inflammation. Of the Mode in which it operates in those Cases. Theories which have been advanced. Proofs that it does not lose it's Elasticity in these Cases. Conjecture that it acts by absorbing and carrying off the inflammable Principle.

VI. Of WATER. It's Simplicity. It's Fluidity and Evaporation, see LECT. 3 and 4. Water considered as the Primary Element. Of it's Conversions and Transmutations. Dispute concerning the Conversion of Water into Earth by Distillation. Experiments of *Boyle*, *Boerhaave*, *Margraaf*, *Hill*, *Lavoisier*. Of the Conversion of Water into Earth by Trituration. *Godfrey's* Experiments. Of the Diminution of Waters on the Earth. Of the *Species* of Water. Species of pure or unimpregnated Water. α. *Distilled Water*. β. *Rain Water*. γ. *Spring Water*. Their comparative Purity.

2. Species of *impregnated* or *mineral* Waters. The number of possible Impregnation. α. *Neutral Salts*. β. *An Acid*. γ. *An Alkali*. δ. *Fixed Air*. ε. *Calcareous Earth*. ζ. *Inflammable*. η. *Metallic Substances*.

stances. *a. Neutral Salts. a. Common Salt. b. Glauber's Salt. c. Sal Ammoniac. d. Alum.*

a. Common Salt. Of SEA WATER. The Degree of Saltiness of the Sea in different Climates. The Origin of the Saltiness of the Sea. Of the Attempts to discover the Age of the World by the Saltiness of the Sea. Of the other saline Impregnations of Sea Water. It's luminous Appearance described. Theories to explain it. Mr. *Canton's Experiments.* Of the Distillation of Sea Water. Dr. *Irving's* and Mons. *Poissonnier's* Experiments. The Quantity and Purity of Water obtained by this Method. Dr. *Watson's* Experiments. Of the Purification of Sea Water by Frost. Of the Ice of Sea Water. Observations and Experiments of *Lord Mulgrave, Capt. Cook* and Mr. *Nairne.* The Degree of Cold required to freeze Sea Water. Dr. *Watson's* Proposal to concentrate Sea Water by Frost.

b. Glauber's Salt. c. Nitre. d. Sal Ammoniac. e. Alum. Doubts concerning the Presence of these Salts in *Spring Waters.* Circumstances which may have deceived Observers concerning them. Of *Mineral Waters* strictly so called, subdivided into, *a. Hot Waters or Thermae. b. Cold Waters or Acidulae.* Of the Heat of thermal Waters, with some Conjectures concerning it's Cause. Of the *Acidulae*; see farther under the succeeding Articles $\beta.$ and $\delta.$

$\beta.$ *An Acid.* Of the *Spirit* of Mineral Waters. Doubts concerning the Presence of the pure Vitriolic, Nitrous or Marine Acids in Springs.

$\gamma.$ *An Alkali.* The fossil Alkali alone can be suspected. How it may be produced. Phænomena of alkaline Waters. Tests of it's Presence. Circumstances,

cumstances, which may have deceived Observers concerning them.

8. *Fixed Air.* Dr. *Brownrigg's* Discovery of this Source of the *Mineral Spirit* of Waters. Evidence of this Impregnation. Conjecture concerning the Mode, in which it is effected. See farther, LECT. 23.

9. *Calcareous Earth.* The *Hardness* of Waters re-considered. See LECT. 18. Modes of correcting this Quality. The two Forms in which Calcareous Earth may be suspended in Waters. a. *By the Loss* of it's Fixed Air. b. *By Supersaturation* with Fixed Air. See LECT. 22. Mr. *Cavendish's* Discoveries illustrated.

10. *Inflammable Substances.* a. With *Bituminous* Fluids. What Degree of Solution may be supposed to take Place in that Case. b. With *Sulphur*. Review of the Arguments adduced to prove or disprove the Presence of Sulphur in Mineral Waters. Dr. *Lucas's* and Dr. *Macbride's* Observations. How the Phænomena of several Waters may be produced without actual Sulphur in Solution.

LECTURE XXV.

1. Of the Impregnation of Mineral Waters with *Metallic* Substances. a. *Iron.* b. *Copper.* c. *Zinc.* Reasons for rejecting *Tin* and *Arsenic* from this Enumeration.

a. Of CHALYBEATE WATERS. Modes in which Iron may be suspended in them. a. By means of the *Fixt* Vitriolic Acid. b. By the *Volatile* Vitriolic Acid. c. By *common* Liver of Sulphur. d. By Liver of Sulphur with *Quick Lime.* e. By *Fixed Air.* These Modes, particularly the last, considered.

b. Of

b. Of COPPER WATERS. The Impregnation always Vitriolic. The Reason why Copper Waters are so uncommon.

c. Of *Waters* containing ZINC. The Reason why such Waters are very uncommon.

Of the *Mode of examining* Mineral Waters. 1. By Evaporation and Distillation. 2. By Crystallization. 3. By Precipitation. 4. By the Use of the blue vegetable Infusions, Tinctures, or Syrups. 5. By Acid and Alkaline Salts. 6. By Lime Water. 7. By Metals. These Modes applied to the Detection of the various Substances above enumerated. The Modes illustrated by the Examination of some celebrated Waters. Abstract of the Dispute concerning the Presence of Sulphur in the *Bath Waters*.

VII. Of ELECTIVE ATTRACTIONS. An Account of the Principles upon which Tables of elective Attraction are constructed. Some of these Tables compared and explained cursorily, to shew their Use and Application. Explanation of some of the Characters and Symbols commonly used in such Tables. Conjecture concerning the Origin of such Symbols. *Single and double Elective Attraction* illustrated.

VIII. Of VEGETABLES.

General Remarks on their Beauty, Utility, and Culture. Of the Nature of their *Food*. Experiments of *Boyle, Hales, &c.* Water considered as the Food of Plants. Of the general Nature and Qualities of *Soils* and *Manure*. Of the Nutriment, which Vegetables derive from the Air. Their inhalant and exhalant Vessels. Proofs that they *inhale* the noxious Particles of corrupted Air. Dr. *Priestley's* Experiments. Of the Effect of Vegetables in purifying Air, which is corrupted by Respiration.

spiration, Putrefaction, or Fire. Of the Attraction of Plants for the Principle of Inflammability, and the Matter of Light. Observations of Dr. *A. Hunter* on this Subject. Proofs that Vegetables *exhale* a purified or dephlogisticated Air. The Laws of this Exhalation. Experiments of *Monf. Bonnet* and Dr. *Ingenhousz*. Of the *Native Salts* of Vegetables. Of the Operation of *saline Substances in Manure*. Of the Detection of metallic and mineral Substances in Vegetables. The *Analysis* of Vegetables. Of their *Vital Principle*. The Laws of Nutrition, Circulation, Secretion, to which they are subject. Of the *Motion of the Sap*. The *Sensibility* of Plants illustrated by some familiar Examples. The Analysis of Plants by Fire farther considered. 1. As conducted in *close Vessels*. Of the Manufacture of *Tar*. 2. In *open Vessels*. Of *Wood Soot* and it's *Salt*. The Preparation and Purification of the Vegetable Fixed Alkali.

LECTURE XXVI.

Of the *Natural or artificial Products* of Vegetables. Their various Fluids. The *Sap*. The Doctrine of Secretion in Animal or Vegetable Bodies very obscure. Reason to believe it takes Place in Vegetables. The Use of the *Nectaria* in Plants discovered by *Linnaeus*.

1. Of the *Natural Products* of Vegetables. *α. Wood. β. Gum. γ. Aromatic Oil. δ. Balsam. ε. Resin. ζ. Unctuous Oil. η. Salt. θ. Sugar. ι. Farina.* General Account of the chemical Properties of these. *α. Of Wood.* See LECT. 5.

β. Gum. It's Qualities. It's Solubility in Water. *Mucilage.* Insolubility of Gum in Spirit of Wine.

Wine. Analysis of Gum. It's Origin and Species. a. *Gum Arabic*. b. *Gum Tragacanth*. c. *Gum Senegal*. Combination of Gum with Oils. *Emulsion*. Properties of Emulsions. Of Native Emulsions or Combinations of Gum with Resin. *Gum-Resin*. Examples of it in many common Plants. The Solubility of Gum-Resins in Water shewn. Explained and illustrated by Specimens. Their Use in Pharmacy pointed out.

γ. δ. ε. *Aromatic Oils, Balsams, and Resins*. Their Qualities already fully explained. See LECT. 17.

ζ. *Unctuous Oils*. See LECT. 18.

η. *Salts*. Some cursory Observations; and the Origin of the Vegetable Alkali farther considered.

ς. *Sugar*. Difficulty of arranging it in a systematic Plan. It's Analysis. It's Solution and Crystallization. It's antiseptic Power. It's saponaceous Quality. It's Medicinal Virtues.

ι. *Farina*. Definition. It's general Properties. It's nutritious Quality. *Bread*. General View of the Analysis of Farina.

Of the *Spontaneous Changes*, which take Place in Vegetable Substances. Of FERMENTATION and PUTREFACTION. The Subjects of these Processes. Of *Malting*. Of the Necessity of Moisture and Heat to Fermentation. Of the Degree of Heat requisite. The Phænomena of Fermentation. Nature of the Elastic Vapour discharged, See LECT. 23 &c. Of the *Lees* and *Head* of fermenting Liquors. The *Vinous* Stage of Fermentation. *Wine*. It's Distillation. *Spirit of Wine*. It's Varieties: *Rum, Brandy, Arrack, Malt Spirit*. The Modes of preserving Wines. Of the Changes, which they naturally undergo. Of the second or *Acetous* Stage of Fermentation. *Vinegar*. Of the third or *Putrefactive* Stage of Fermentation. The

Natural Progress of Fermentation without the Assistance of Art. Of the Resolution of Vegetables by Putrefaction. The Residuum compared with that, which is left by their Inflammation. Some Conjectures concerning the Origin of Clay. Of the Effluvia of putrifying Vegetables. Their Nature and Effects. Artificial Modes of *promoting* these spontaneous Changes. The Use and Operation of *Ferments*. Observations on the Influence of Fermentation in extracting the Aroma &c. of Plants. *Medicated Wines* and *Ales*. The Modes of conducting, restraining, and suppressing Fermentation. *α.* By boiling; *β.* By saline Substances; *γ.* By Sulphur. Some Effects of Lightning remarked. *δ.* By Exclusion of Air. Artificial Modes of *preventing* the spontaneous Changes in Vegetables; that is, *the Modes of preserving Vegetables*. *α.* By *Exsiccation*. Rules for conducting this Process. *β.* By *Exclusion from Air, Heat and Insects*. Illustrations of these: *γ.* By *Antiseptics*. *a.* By *Common Salt*. Method of making *Sour Krout*. Antiseptic Efficacy of this Preparation. *b.* By *Vinegar*. *c.* By *Sugar*. Preparation of Syrups, Candies, Conservees, Jellies.

2. Of Vegetable Productions separated by Art. *α.* by *Incision* or *Bleeding*. Instances of this Process described. *β.* By *Expression*. Description of the Machines for expressing unctuous Oils, the Juice of the Sugar Cane, some Juices, thence called Expressed Juices, and some Essential Oils. *γ.* By *Solution*. *a.* In *Water*. Modes of increasing it's solvent Power enumerated. The Operations of *Infusion, Maceration, Digestion, and Decoction* described and distinguished. The Efficacy of Lime Water as a solvent exemplified. *b.* In *Wine*. Of Medicinal Wines. Limitation of the Term. *c.*
In

In *Spirit of Wine*. The Subjects of it's Action. The Preparation of *Tinctures*, *Balsams*, and *Elixirs*. d. By *Vinegar*. Application of this solvent in Pharmacy exemplified in the *Vinegar of Squills* and *Vinegar of the four Thieves*. e. By *expressed Oils* exemplified in the *Green Oil*, *Oil of Hypericum*, and *perfumed Oils*.

δ. By *Inspissation*. The Subjects of this Operation illustrated by an Account of the Preparation of *Inspissated Juices*, *Robs*, *Honeys*, and *Extracts*.

ε. By *Evaporation* of the Juices to *Crystallization* instanced in the Preparation of *Essential Salts* and *Sugar*.

ζ. By *Sublimation*, instanced in the Preparation of *Flowers of Benjamin*.

η. By *Distillation*. a. By *Distillation per Descensum*, as in the Preparation of *Tar*. b. c. By *Distillation per Ascensum vel ad Latus*, instanced in the *Distilled Waters*. *Simple distilled Waters*, *Spirituos* or *Compound Waters*. Directions for their Preparation and Preservation.

θ. By *Inflammation*; as in the Preparation of the *Vegetable Fixed Alkalies*.

IX. Of ANIMAL SUBSTANCES. A general View of the Nature of Animal Matter. It's Composition and Analysis. Distinction between Animal and Vegetable Matter exemplified in the Oils and Salts expelled from them by Heat, and in the Residuum. The Nature of the Acid expelled by Fire from Animal Substances. Some Conjectures concerning it's Origin. Of the Progress of Putrefaction in Animal Substances, and the Means of retarding it. Of *Antiseptic* substances: Salt, Nitre, Sugar. Of *Septic* Substances: Calcareous Earth the only Example. Conjectures concerning it's Operation. Of the Degree of Heat most favourable

able to the Putrefaction of Animal Matter. The *particular* Consideration of Animal Substances, arranged under 2 Heads: 1. Of the *Solids*; 2. Of the *Fluids*.

1. Of the *SOLIDS* of *Animals*. General Analysis of them by Fire. By Distillation. The Preparation of *Salt*, and *Oil of Hartshorn*. It's Rectification. Of the solvent Power of Water with Respect to Animal Substances. Preparation of *Animal Jellies*, *Glue*, and *Isinglass*. The Use of *Papin's Digester*. See LECT. 4. The Effect of Chemical Menstrua particularly Spirit of Salt on Animal Matters.

2. Of the *FLUIDS* of *Animals*. Distinction between the Circulating and Secreted Fluids.

A. Of the *Circulating Fluid*, THE BLOOD. It's general Appearance, Qualities, and Composition. It's Distillation. The natural Separation of the Blood into two Parts. *α. Serum. β. Crassamentum*. The Essential Difference between these two Parts. *Leuwenhoek's* Discovery of the *Red Globules* of the Blood.

α. Of the Serum. It's general Appearance and Qualities. The Effect of Heat upon it. It's Coagulation. The Changes, which the coagulated Mass undergoes on Exposure. Some Observations on the common Mode of clarifying Liquors. Of the Coagulation of the Serum by Acids. Of the *Albumen* of the Serum.

β. Of the Crassamentum. Consists of two principal Parts. *a. The coagulable Lymph. b. The Red Globules*.

a. Of the Coagulable Lymph. It's Difference from the Albumen of the Serum. Of it's Coagulation. Modes of obtaining it separate. The general Doctrine

trine of the *Size* or *buffy Coat* of the Blood. Mr. *Hewson's* Observations.

b. Of the *Red Globules*. The best Method of examining them. The Theories built upon this Discovery by *Leuwenhoek*, *Boerhaave*, *Martine*. Objections. Of the Formation and Form of the Red Globules. Of the Use of the saline Part of the Serum. Conjecture concerning the Organs in which the Red Globules are formed. Of the florid red Colour of the Blood. The Effect of the Air in producing it, by Sign. *Cigna* and *Beccaria*. Dr. *Priestley's*, and other Theories of this Effect. *Priestley's* Experiments.

Of the Effect of Putrefaction on the Blood. The Resolution of Coagula by Putrefaction. Of the Alkali generated in the Blood by this Change.

B. Of the *Secreted Fluids*. α. The *Excrementitious Fluids*. β. Those which are secreted and reserved for useful Purposes in the Animal Oeconomy.

α. Of *Excrementitious Fluids*. The gradual Progress of Animal Bodies to Decay. Species of these Secretions. a. *The Perspirable Matter*. b. *The Urine*. c. The Fluid discharged in the *Intestines*.

a. Of the *Perspiration*. It's Nature more particularly investigated.

b. Of the *Urine*. The Office of this Secretion. The mixt Contents of the Urine. It's Saline Parts. It's peculiar Salt. The *Phosphoric* or *Fusible Salt* of Urine. It's Properties. The Mode of obtaining it in a crystallized State. It's Composition. It's peculiar Fixity. It's Use in the Preparation of *Phosphorus of Urine*. The Discovery of *Phosphorus* by *Kunckel*. *Margraaff's* and *Beaumè's* Improvement of the Process. It's Nature farther examined. Of it's Acid. See LECT. II. It's Fusibility and Inflammability. Experiments to illustrate

trate these. It's Solubility in Essential Oils, and Æther. Experiments with this Solution. The Consideration of Urine resumed. Of the Natural Separation of it's Parts *out* of the Body. Causes which influence this Separation. Causes which produce the same separation *within* the Body. Of *Calculous Concretions* in the Kidneys and Bladder. An Attempt to illustrate their Formation. Their Composition not always the same. Of their Solution. Arguments to shew the Improbability of such solution. Of the Relief of calculous Symptoms.

c. Some cursory Observations on the Fluid discharged by the *Intestines*.

β. Of the Fluids secreted and reserved for important Purposes in the Animal Oeconomy.

a. The Fluid, which is intended for the *Lubrication or Defence* of Parts. b. The Fluids subservient to *Generation*. c. Those, which assist in *Digestion*. d. Of *Milk*. e. The Fluid of the *Nerves*. The first, second, and last of these Divisions cannot come within Reach of chemical Examination, and therefore are not within our Plan.

c. Of the *Fluids* concerned in *Digestion*. a. The *Saliva*. b. The *Gastric* and *Pancreatic* Fluid. c. The *Bile*.

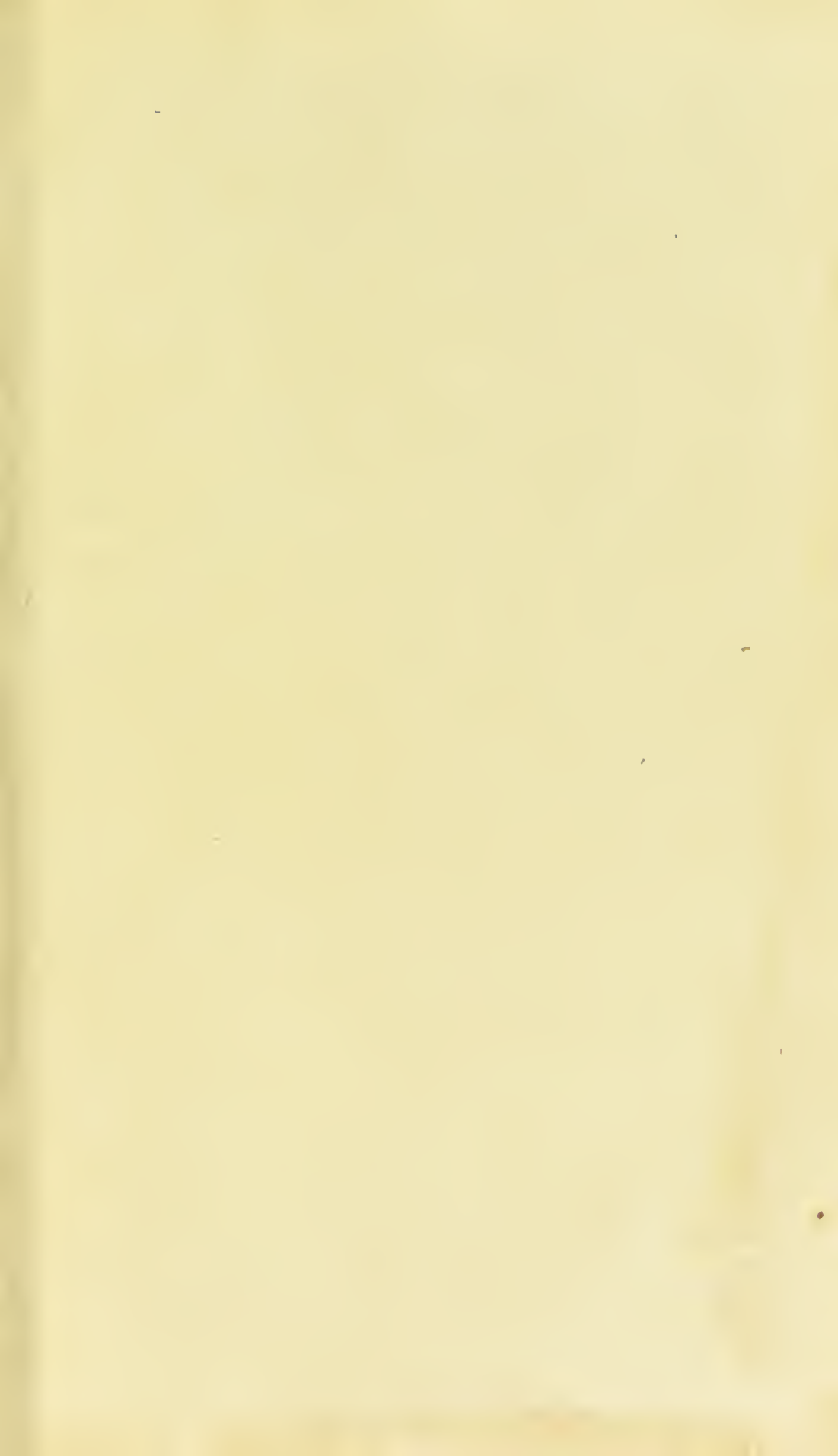
a. Of the *Saliva*, It's Secretion and it's Properties. It's solvent Power according to the Experiments of *Pringle* and *Macbride*. Of the Deposition of the Tartar of the Teeth.

b. Of the *Gastric Fluid*. Difficulty of making Experiments upon it. It's Solvent Power shewn by the Experiments of Mr. *Reaumur*, and Mr. *Hunter*. Account of these Experiments. Of *Digestion*, and the different Theories concerning it. Proofs that the solvent Power of the Gastric Fluid, has

has a principal Influence in that Process. The Degree of Mechanical Pressure which concurs in the Operation. Of the Digestion of the Stomach by it's own Fluids after Death. Observations of Mr. *Hunter*. The Power of the Vital Principle to resist the Action of the Gastric Fluid. Some general Remarks on the Qualities of the *Pancreatic* Fluid.

c. Of the Bile. It's general Appearance and Secretion. It's supposed Alkaline and saponaceous Quality considered. Some of it's Properties more particularly specified. The Mode in which, though not Alkaline, it may produce some of the same Effects as an Alkali. Dr. *Percival's* Observations. *Of Biliary Calculi*: Their Nature, Formation, Solution, and Evacuation, cursorily considered.

d. Of Milk. The spontaneous Separation of Milk: *Curd*; *Cream*; *Whey*. Of the Production of *Butter*. The Evaporation and Crystallization of *Whey*. *Sugar of Milk*. The Coagulation of Milk by Acids: by nitrous Spirits. Comparison between the most common Species of Milk: *Cow's Milk*; *Ass's Milk*; *Woman's Milk*; *Goat's Milk*; Some medicinal Observations deduced from there Remarks. CONCLUSION.



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